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Washington, DC

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16. ABSTRACT

The System Design and Development Guidance presents a framework for the acquisition and management of information technology within EPA. This guidance also establishes cost effective standards and procedures to ensure quality of EPA software design, development, implementation and maintenance.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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10/87

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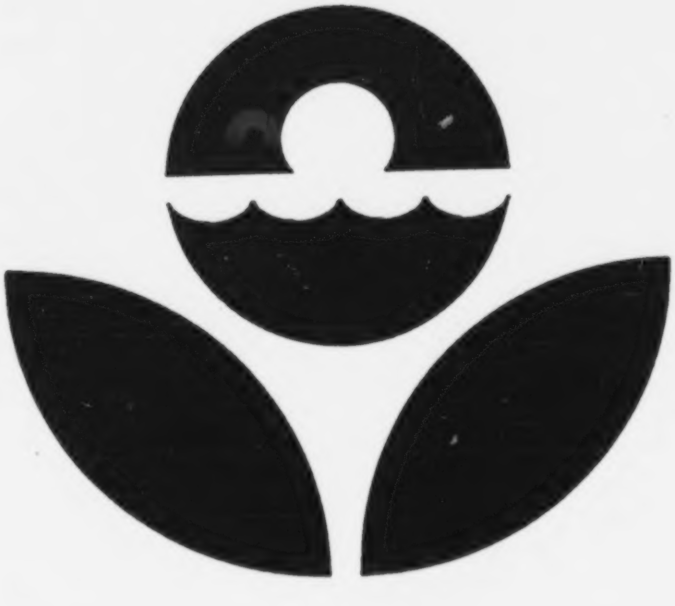

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10/87

EPA SYSTEM DESIGN & DEVELOPMENT GUIDANCE:

VOLUME A: MISSION NEEDS ANALYSIS

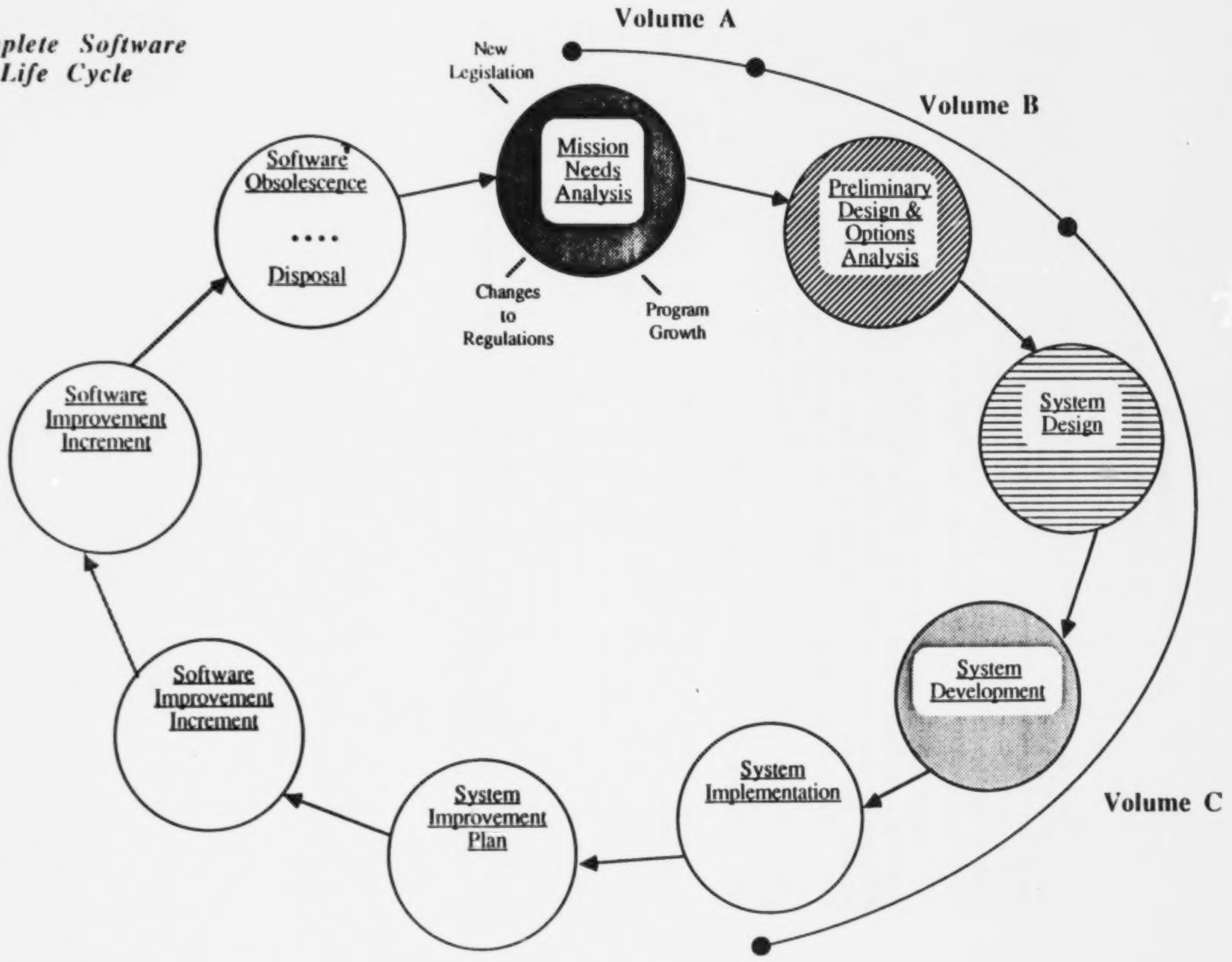
Volume A
Executive Summary

This document constructs a framework around which Agency program managers and contracting officers can document a problem and justify the need for an information processing solution. The objective of this document is to provide guidance towards satisfying requirements specified in EPA's IRM Policy Manual for the acquisition and management of information technology.

The guidelines within this document are designed to provide program managers and their staff with a suggested methodology for assessing and evaluating the need for information processing. Applying the methodology in this volume will result in two outputs: 1) a preliminary specification of a management requirement for information or information processing; and the outputs and benefits tied to the user's organization mission and operation, and 2) an "Initial System Concept" which provides an initial depiction of the inputs, outputs, and processes.

Completion of the steps outlined in this document will provide management with the information required to make a decision whether or not to proceed to the Preliminary Design and Options Analysis task defined in Volume B. The following exhibit describes the complete software life cycle. Each process in the software life cycle is represented by a circle with its corresponding title on the inside of the circle. Inputs to the Mission Needs Analysis or factors that influence the process are shown surrounding the circle. As indicated, influencing factors are: new legislation, changes to regulations, program growth and the preceding process Software Obsolescence.

Complete Software Life Cycle


Volume A
Volume B
Volume C
New Legislation
Changes to Regulations
Program Growth
Mission Needs Analysis
Preliminary Design & Options Analysis
System Design
System Development
System Implementation
System Improvement Plan
Software Improvement Increment
Software Improvement Increment
Software Obsolescence
....
Disposal

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1. INTRODUCTION

Pursuant to the Environmental Protection Agency's IRM Policy Manual, this volume is the first of three volumes which provide guidance for Agency system design and development efforts. This volume provides guidance for the first phase of the EPA system development process --- The Mission Needs Analysis.

Volume A is intended for use by Agency Program and Management Officials and responsible staff when making a determination regarding an information or information processing need and whether to commit resources to identify, develop, and implement an appropriate solution to satisfy that need.

1.1 BACKGROUND

The Environmental Protection Agency expends millions of dollars each year on the design, development, implementation and maintenance of major environmental and administrative systems vital to EPA's programs and administrative functioning. Management of these system resources is becoming increasingly complex, since the rapid development of information technology in the 1980's has dramatically increased computer capacity and user accessibility. The result has been two-fold:

- An increasing number of system development efforts by managers and staff at all organizational levels who, because of access to their own equipment, develop their own systems independently of Agency systems staff
- A wide range of hardware/software options for implementation of any specific system concept or design.

Therefore, there has been a proliferation of system development efforts by a broad range of users with varying levels of sophistication in making system development decisions and conducting system development efforts.

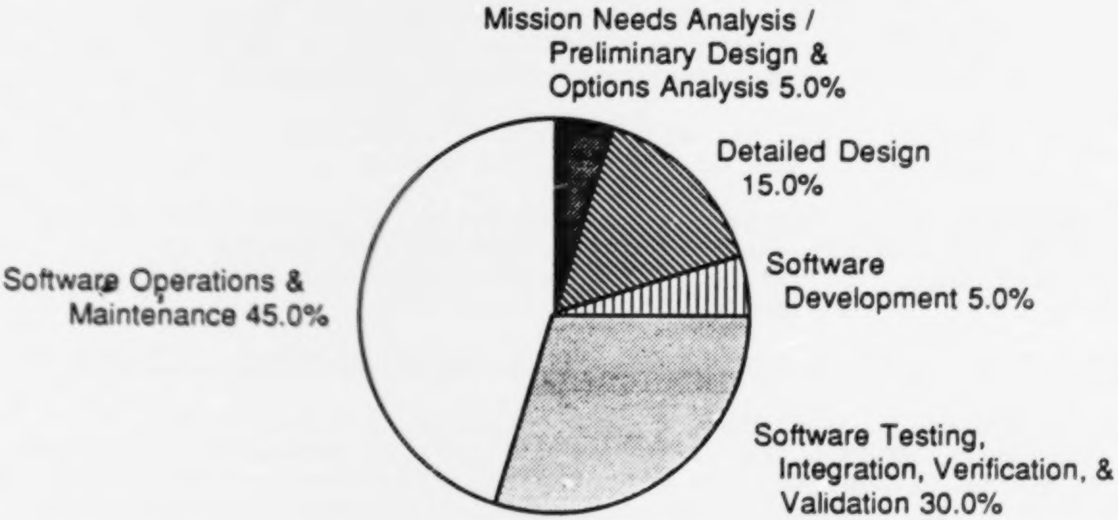
1.2 OBJECTIVES OF THE SYSTEM DESIGN AND DEVELOPMENT GUIDANCE

Within EPA's Office of Administration and Resources Management (OARM), the Office of Information Resources Management (OIRM) is responsible for ensuring the effective and efficient use of EPA's information resources including automated system design, development and maintenance. OIRM's objective in this endeavor is to provide guidance, assistance, and only when necessary, controls, to assure that the Agency's considerable information resources are utilized cost-effectively for the overall benefit of the Agency. To this end, OIRM has developed umbrella policies guiding information system development and acquisition (see Information Resources Management Policy Manual) and has also developed this three-volume set of guidelines and standards to assist with EPA's system development efforts. These three volumes provide sequential guidance for:

- Defining the system requirement (or need) and related operating concept
- Developing feasible system options and selecting the most cost-effective option
- Designing, developing and implementing the selected system option.

Exhibit 1-1, following this page, graphically depicts the three major phases of the system development life cycle and the decisions and results expected of each phase. However, EPA's system development life cycle discussed in these volumes represents little more than fifty-five percent of the total life cycle of a software application. Typical cost allocations for each major component of the total system life cycle are represented in the graph below.

Life Cycle Costs [1]



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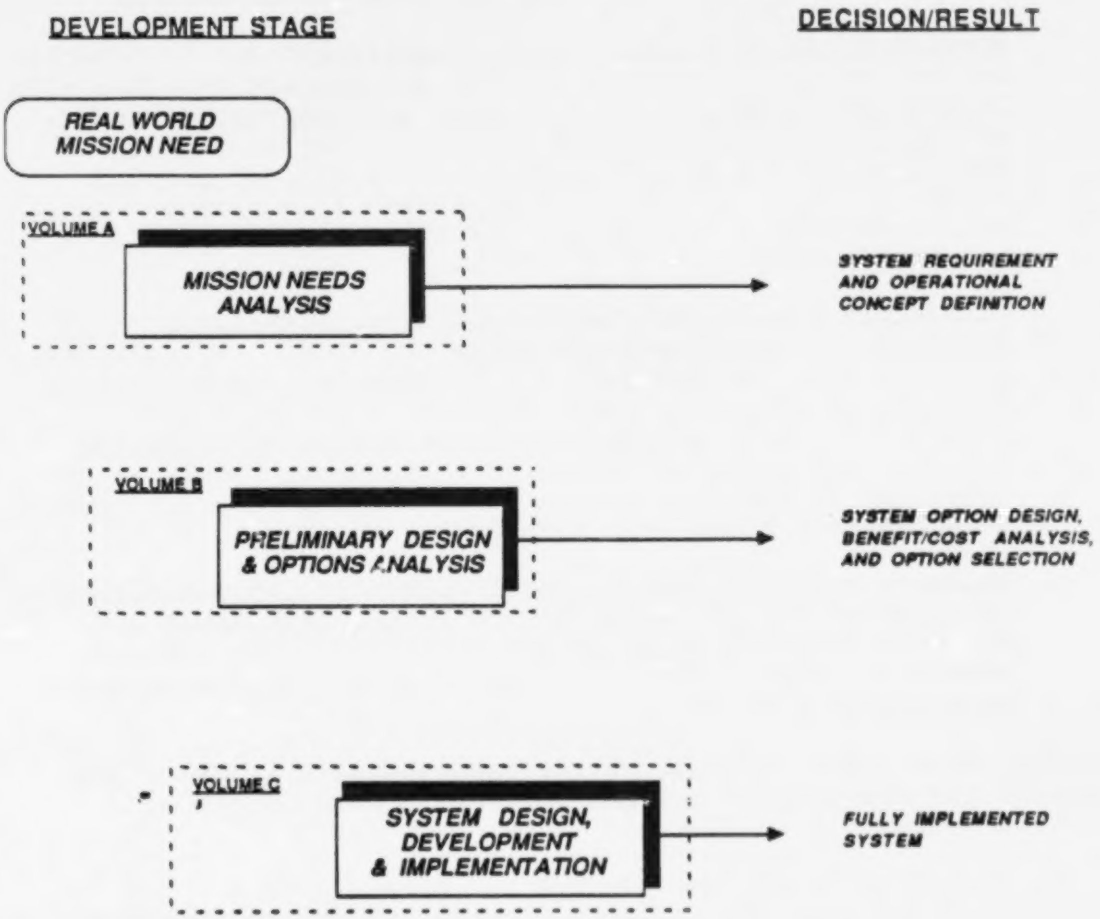
[1] These figures are based on a graphic illustration in Controlling Software Products by Tom DeMarco, 1982, which purports to represent industry averages.

EXHIBIT 1-1

EPA SYSTEM DEVELOPMENT LIFE CYCLE & DECISION PROCESS


DEVELOPMENT STAGE
DECISION/RESULT
REAL WORLD MISSION NEED
VOLUME A
MISSION NEEDS ANALYSIS
SYSTEM REQUIREMENT AND OPERATIONAL CONCEPT DEFINITION
VOLUME B
PRELIMINARY DESIGN & OPTIONS ANALYSIS
SYSTEM OPTION DESIGN, BENEFIT/COST ANALYSIS, AND OPTION SELECTION
VOLUME C
SYSTEM DESIGN, DEVELOPMENT & IMPLEMENTATION
FULLY IMPLEMENTED SYSTEM

This document is the first of the three-volume set. The volumes cover the following:

- Volume A - Mission Needs Analysis -- is designed to provide program managers and staff with a suggested methodology for assessing and evaluating the need (requirement) for an information system. Applying the methodology in this volume will result in two outputs: 1) a preliminary specification of the management requirement for information or information processing and the outputs and benefits tied to the user organization's mission and operations, and 2) an "Initial System Concept" which provides an initial depiction of the system's input, processes and outputs. These results: 1) confirm that a need (requirement) exists and 2) provide a preliminary operational specification of the requirement.
- Volume B - Preliminary Design and Options Analysis -- is directed towards program managers and staff. It provides guidance and a methodology for structuring design options for meeting the requirement defined in Volume A and provides guidance for selecting the most cost-effective option. The steps described in this volume result in the selection of the most mission/cost-effective option (manual or automated) based upon life cycle concepts.
- Volume C - System Design, Development And Implementation -- is intended for use primarily by system developers and provides specific guidance and standards which must be adhered to when undertaking automated system design and development efforts.

Together these three volumes provide comprehensive guidance and standards for the orderly and cost-effective development of automated systems.

It should be noted that the EPA has established a comprehensive information security program through Chapter 8 of the IRM Policy Manual. Because retrofitting security measures into software under development is complex, expensive and risky, security considerations need to be an integral part of the system development life cycle. Consequently, security issues and factors are identified at appropriate points throughout these volumes. A detailed discussion of security design and development considerations is beyond the scope of this guidance. Additional security guidance will be provided in the forthcoming EPA Information Security Manual.

1.3 AUTHORITY

The EPA System Design and Development Guidance derives its authority from Chapter 4 of the IRM Policy Manual, entitled "Software Management," which establishes the Agency Software Management Program. The guidance serves as the primary guidance for Agency system design and development efforts.

1.4 APPLICABILITY OF THE GUIDANCE

Senior Agency managers and responsible staff should read the guidance and become familiar with the decision-making process involved with system design and development efforts. They are responsible for ensuring adequate analysis and documentation to support the critical decisions/results illustrated in Exhibit 1-1. The full documentation requirements for automated system development efforts, which must be followed to conform to OARM policy, are fully discussed in Volume C.

In general, Volumes A and B are intended to assist program offices and/or users in conducting their own initial studies of system requirements, needs, option feasibility and cost-effectiveness. In this context, the term "system" in Volumes A and B refers to a systematic set of processes and/or procedures which can be used to meet the information needs of a user. It does not imply that the "system" will be an automated system.

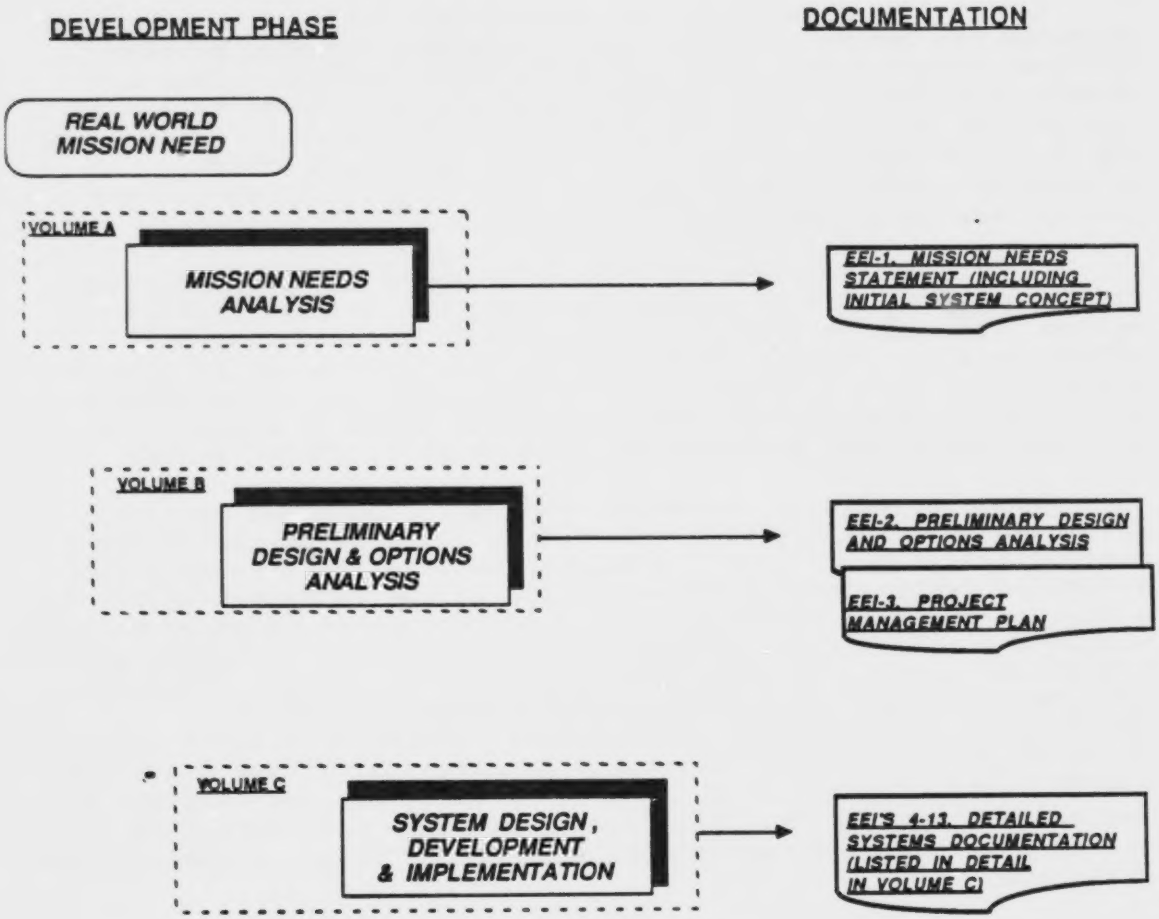
Volume C, however, presumes that an automated or partially automated solution has been selected as a result of the Volume B options analysis. Volume C provides guidance and standards for automated system development efforts. If the automated system is a relatively small application on a microcomputer targeted for use within a single office (a "user owned information system"), Volume C provides simplified requirements for system design, development and implementation. If the proposed system is a larger application (mainframe or minicomputer), which is mission-critical or involves multiple offices and organizations, Volume C provides the full set of guidance and standards which must be followed by system developers. This will assure uniform, cost-effective system development in accordance with EPA policies, guidelines and standards.

1.5 DOCUMENTATION REQUIREMENTS

In general, the intent of the three-volume System Design and Development Guidance is to provide a consistent focus for system development efforts which will allow both EPA program managers and OARM managers to cost-effectively develop and maintain the Agency's systems. To achieve this goal, certain documentation requirements (termed "Essential Elements of Information" (EEI) documents) must be met. Exhibit 1-2, following this page, summarizes the EEI documentation requirements. As shown,

EXHIBIT 1-2

EPA SYSTEM DEVELOPMENT LIFE CYCLE DOCUMENTATION


DEVELOPMENT PHASE
DOCUMENTATION
REAL WORLD MISSION NEED
VOLUME A
MISSION NEEDS ANALYSIS
EEI-1. MISSION NEEDS STATEMENT (INCLUDING INITIAL SYSTEM CONCEPT)
VOLUME B
PRELIMINARY DESIGN & OPTIONS ANALYSIS
EEI-2. PRELIMINARY DESIGN AND OPTIONS ANALYSIS
EEI-3. PROJECT MANAGEMENT PLAN
VOLUME C
SYSTEM DESIGN, DEVELOPMENT & IMPLEMENTATION
EEI'S 4-13. DETAILED SYSTEMS DOCUMENTATION (LISTED IN DETAIL IN VOLUME C)

documentation required for the first two phases of the process -- Mission Needs Analysis and the Preliminary Design and Options Analysis -- are limited to one and two documents, respectively. All system development efforts are subject to the documentation requirements of these first two phases as set out in Volumes A and B.

If a full information system development effort is anticipated after the first two phases, then a traditional series of system design and development documents must be developed and submitted as shown in Exhibit 1-2.

For certain system development efforts OIRM and office Senior Information Resources Management Officials (SIRMOs) must be involved in a review capacity to fulfill EPA's IRM Policy Manual requirements. Systems falling into one or more of the following categories must have OIRM/SIRMO review involvement:

- EPA mission critical
- States, local governments or other Federal agencies involved
- Interorganizational involvement (e.g., between Assistant Administratorships or including Regional Office involvement)
- Costs for system development/enhancement are projected to exceed $250K (excluding costs associated with long-term system operation and maintenance)
- Information security issues involving the three general security areas: applications security, installation security and personnel security. In total, information security involves the precautions taken to protect the confidentiality, integrity and availability of information
- Privacy Act or confidential business information involved.

For system development efforts falling into any one of these categories, OIRM and office SIRMOs must be involved beginning with a review of EEI-1, generated at the conclusion of the Mission Needs Analysis, as described in this volume of the EPA System Design and Development Guidance. OIRM/SIRMO review involvement will continue through the development life cycle of these systems and will include all EEI documentation requirements for such systems.

For systems not falling into one of the above categories, EEIs may be forwarded to OIRM/SIRMOs for information and review as they are developed.

Automated systems involving information security will be subject to one additional documentation requirement -- completion of a certification form (certification of sensitive systems is an OMB requirement). The form, which is under development and will be issued as part of the forthcoming EPA Information Security Manual, will capture basic information on system sensitivity, security requirements, security design, reviews, test scenarios, results and safeguards. Information needed to complete the form will be readily available in the EEI documentation. Prior to the system being placed into use or production, the cognizant SIRMO (or other senior official in the AA/RA's office) will need to certify that the automated system is adequately safeguarded based on the information in the form.

It is not OIRM's intent to burden EPA managers with a host of documentation requirements for each system development effort. The EEIs simply stress typical documentation requirements and their outlines highlight major topics that need to be considered for any system development effort. Managers may use their professional judgment in substituting, combining, or down-scaling the content of the EEIs to meet the unique requirements of their project. Additionally, the EEIs set out in this volume are not meant to conflict with or add more burden to documentation requirements set out in other manuals (e.g., EPA/NCC ADABAS Application Development Procedures Manual). Documentation produced according to such other procedures will invariably satisfy, either partially or fully, some EEI requirements.

Criteria for determining the minimum EEI documentation for a specific system during the design, development and implementation phase is based on the nature and scope of the information system and its importance to EPA's mission. Four types of systems with differing levels of EEI documentation requirements are identified as follows:

- Major Agency Information System: An information system that requires special attention because of its importance to an Agency mission; its high development, operating, or maintenance costs or its significant impact on administration of Agency programs.

- Widely Accessed Information System: An information system that is not a Major Agency Information System (although it significantly supports accepted program goals and missions) but is widely accessed by a combination of EPA Headquarters, Regional Offices and/or state and local users and other Federal agencies.

- Localized Information System: An information system that is not a Major Agency Information System but significantly supports accepted program goals and missions and is accessed primarily by users in one major area, e.g., EPA Headquarters, a single Agency program, or a Region.

- User Owned Information System: Unique, stand-alone system developed to improve the efficiency or effectiveness of operations for a single user or a small group of users.

Documentation requirements for each of these system categories are projected in Exhibit 1-3 on the next page and in Chapter 4 of Volume C. Policies and procedures covering the submission, review and approval of EEIs by OIRM will be issued under separate guidance.

1.6 ASSISTANCE AND SUPPORT AVAILABLE

Agency Program Management officials embarking on a system development effort should be aware that there are at least two sources available to them for assistance and support during the system development life cycle:

- Within each AA/RA's office SIRMOs are available for assistance, support and guidance relative to the EPA Systems Design and Development Guidance and other OIRM guidance and standards (e.g., Core Systems, Structured Programming, etc.)

- OIRM, with its general IRM management oversight role and requirements to exercise procurement approval authority, has a staff organized to support EPA's administrative, program and research communities.

It is appropriate to involve these support sources as early as is feasible in the system development life cycle for most system development efforts.

The primary reasons for early involvement of SIRMOs and OIRM staff are:

- Fulfilling EPA's IRM policy for system development review requirements

- Providing a value-added service role involving consultation, assistance, technical standards, guidance and interpretation of requirements

- Expediting procurement for system development efforts which proceed to the system design, development and implementation phase

- Providing assistance in determining user needs as early as possible in the life cycle.

EXHIBIT 1-3

SYSTEM CATEGORY /EEI MATRIX

EEI Requirements / System Category	Systems That Require OIRM Involvement [1]	Major Agency Information Systems	Widely Accessed Information Systems	Localized Information Systems	User Owned Information Systems
EEI-13 System Integration Test Report	●	●	●	●	
EEI-12 Software User's Reference Guide	●	●	●	●	●
EEI-11 Software Operations Document	●	●	●	●	●
EEI-10 Software Maintenance Document	●	●	●	●	●
EEI-9 Software Detailed Design Document	●	●	●	●	●
EEI-8 Software Preliminary Design Document	●	●	●		
EEI-7 Software Test and Acceptance Plan	●	●	●		
EEI-6 Software Management Plan	●	●	●		
EEI-5 System Detailed Requirements Document	●	●	●	●	●
EEI-4 System Implementation Plan	●	●	●	●	
EEI-3 Project Management Plan	●	●	●	●	
EEI-2 Preliminary Design and Options Analysis	●	●	●	●	
EEI-1 Mission Needs Analysis	●	●	●	●	●

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[1] As detailed on page 1-7.

Achieving these objectives will strengthen EPA's system development efforts and avoid major pitfalls that have beset system development efforts in other government agencies (e.g., project stalls due to outyear funding shortages stemming from under-projected planning or project disruptions due to failure to get hardware/software acquisitions into the procurement cycle expeditiously and when required).

The remainder of Volume A provides requirements for conducting the first phase of the system development process -- the Missions Needs Analysis, including development of the Initial System Concept.

2. CONDUCTING THE MISSION NEEDS ANALYSIS AND DEVELOPING THE INITIAL SYSTEM CONCEPT

This chapter provides guidance for the first and most critical stage in initiating any system development effort -- the Mission Needs Analysis.

The decision to initiate system development efforts should be based on a perceived or existing mission-based information or information processing need. This need may be prompted by any number of factors such as new legislation, changes in regulations, or program growth which may create needs for additional data, changes in practices or additional demands on existing functions and resources.

As a result of the Mission Needs Analysis, the manager should have a complete understanding of the problem and be able to demonstrate that the problem and solution are within the manager's organizational mission. This will provide the manager with the necessary information to justify the need for the project which is then used to obtain procurement authority for the required resources. The manager should be aware of the fact that once the definition of the needs has started, adequate in-house or contractor resources must be available to complete it.

Successful development and implementation of any system requires careful review, understanding, and documentation of the need for information and the functioning of the information processes in the context of the user organization's mission and operational framework. It is, therefore, critical that the "mission-based need" be reviewed as the first step towards establishing and defining the requirements for the system.

Project managers should be aware of the types of activities involved in software development efforts and allow for slippage in schedules due to uncertainties and unknowns. Planning for these activities and making estimates is a difficult task for any manager that does not do this full time. Cost and time factors associated with implementing and managing a software development effort are dependent on such factors as size of the project, levels of complexity and the skill level, experience and length of time the project team has been together.

However, it is vital that managers begin making and recording their estimates early in the project life cycle so they can compare them with actual recorded program costs and hours. It is this iterative effort of comparing planned versus actual performance that allows the manager to develop more accurate estimation skills for future planning efforts.

Information collected during the Mission Needs Analysis:

- Specifies the nature of the program mission, problem, functions, processes and information flows

- Validates the need for information or information processing in the context of the organizational mission

- Provides the basis for developing and evaluating an "Initial System Concept" which will meet the need.

The five steps required to conduct a complete Mission Needs Analysis and develop an Initial System Concept are as follows:

- Step 1 - Background review of the evolution of the system need, a concise statement of the problem and a review of the user's mission, organizational structure and operational processes. The analysis focuses on the positions and functions of those individuals who will be the users of the completed system. The result of this review should be a preliminary list of potential users of the system.

- Step 2 - Identification and specification of the information flow, transactions and outputs the system must or potentially could produce. The result of this step is the development of a concise (perhaps one page) Initial System Concept.

- Step 3 - Testing and/or evaluation of the system concept by reviewing the concept and preliminary output "designs" with potential users to test their usefulness and identify actual or potential constraints.

- Step 4 - Final specification and documentation of the results of the previous steps through development of a Mission Needs Statement.

- Step 5 - Initiation of the Project Management Plan as a preliminary document to facilitate the planning and scheduling of resources for the activities that follow the Mission Needs Analysis.

The actual approach to conducting the Mission Needs Analysis involves conducting the first four steps, and requires continual review, revision and recycling of steps as the analysis proceeds. The suggested approaches for conducting each of these steps are presented below.

2.1 STEP 1 - REVIEW OF SYSTEM NEED BACKGROUND AND THE MISSION AND ORGANIZATIONAL NEEDS

The Mission Needs Analysis should begin with a careful review of the organizational and operational context from which the need evolved and the specific users which the system or systematic solution is intended to assist. The first task is to determine the genesis of the initially identified and/or defined need. Some possibilities include:

- A new program or set of mission functions have been mandated by the President, Congress or senior officials, requiring the performance of new tasks, processes and/or systems
- A manager has decided to perform a new function or an existing function using different procedures in support of the Agency's mission, goals and objectives
- An existing process or system has been evaluated and is suspected of being inefficient, ineffective or obsolete.

In each of these cases it is important to review the evolution of the system need to determine which of these possible causes was principally responsible for the system development effort. Clearly identifying which of these causes is the basis for the system requirement is important to future development efforts since knowing the reason for the need helps:

- Define the problem in concise terms including any quantifiable facts or conditions related to the problem. For example, "The program office is unable to respond to Freedom of Information Act (FOIA) requests for data due partly to a fifty percent increase in FOIA requests and a five percent effective reduction in force."
- Define the specific set of users and uses
- Establish the likely priority accorded the effort by senior Agency officials and responsible staff
- Determine whether the problem is really one requiring a system solution or has some other underlying cause.

In conducting this background review, two primary data collection methods may be used:

- Interviews with key officials, managers and staff involved or potentially involved in the processes to be systematized and those who will be the end users of the system results. These user interviews should focus on what specific outputs are required of the system and what benefits users anticipate.

- Collection and review of key documents such as relevant legislation, agency policies or operational plans, organizational mission/function statements or previous studies of the function or process.

The results of the data collection efforts should be reviewed to provide those conducting the Mission Needs Analysis with a clear picture of the operational context within which the system will operate.

Perhaps the critical output of this initial review is a preliminary identification of users and potential benefits of system outputs. A summary format for displaying this information in a matrix format is provided below:

Potential System User/ Organization	Position/ Function	System Output	User Benefit

It is important that to the extent practical, this type of matrix be completed for all major users to ensure adequate consideration of user needs and system benefits.

2.2 STEP 2 - IDENTIFICATION AND PRELIMINARY SPECIFICATION OF SYSTEM INPUTS, PROCESSES AND OUTPUTS AND DEVELOPMENT OF THE "INITIAL SYSTEM CONCEPT"

Conducting Step 1 will result in the identification of the potential system users, uses, outputs and benefits. During this second task, the "flow" of information and work processes of the potential system application are developed and documented. The purpose of this step is to develop an overall understanding and preliminary design for the flow of information and information products. At the conclusion of this step, a brief (perhaps one page) Initial System Concept is developed. In addition, the documentation of the information flow ultimately provides the basis for:

- Determining the manual processes and procedures which will become a part of the ultimate "system solution" for the need or problem (any and all automated systems have a set of manual processes and procedures which support the automated portion of the "system" and distribute its output)

- Identifying and specifying the procedures and functions which may be automated and therefore may become the "automated system" which will be designed.

The flow of information or work processes that are candidates to be systematized can be examined through overall flow charting processes that depict, on a macro level, the:

- Organizations and key individuals involved in the information flow and information products

- The input processes and documents which feed and support the system

- The specific output products.

Exhibit 2-1 illustrates a format for a sample flow chart which can usefully depict such information. As shown, the flow chart contains these important elements:

- A stub (vertical axis), containing the major organizations and/or individuals involved in the process including those involved in:

    - Input processes
    - Information process flow
    - System operation
    - System output and use.

- The flow and interrelationships of information among the various involved organizations

- Specifically identified outputs of the system.

The creation of a flow chart similar to, and at the approximate level of detail as, that shown is highly recommended. It is a systematic methodology for identifying the specific inputs, information flow and system outputs. This flow chart can usually be constructed from a combination of existing documentation and limited interviews with affected organizations and staff.

Based upon the flow chart, a higher level (ideally one page) Initial System Concept document should be developed as in Exhibit 2-2. The concept should illustrate:

- Major system input documents/sources on the left side

- A very brief description of key "processes" and/or data files in the center

- Graphic depictions of system "outputs" on the right side.

In most cases it should be possible to construct the "Initial System Concept" on one page.

EXHIBIT 2-1

PROCESS FLOW OF SITE INFORMATION

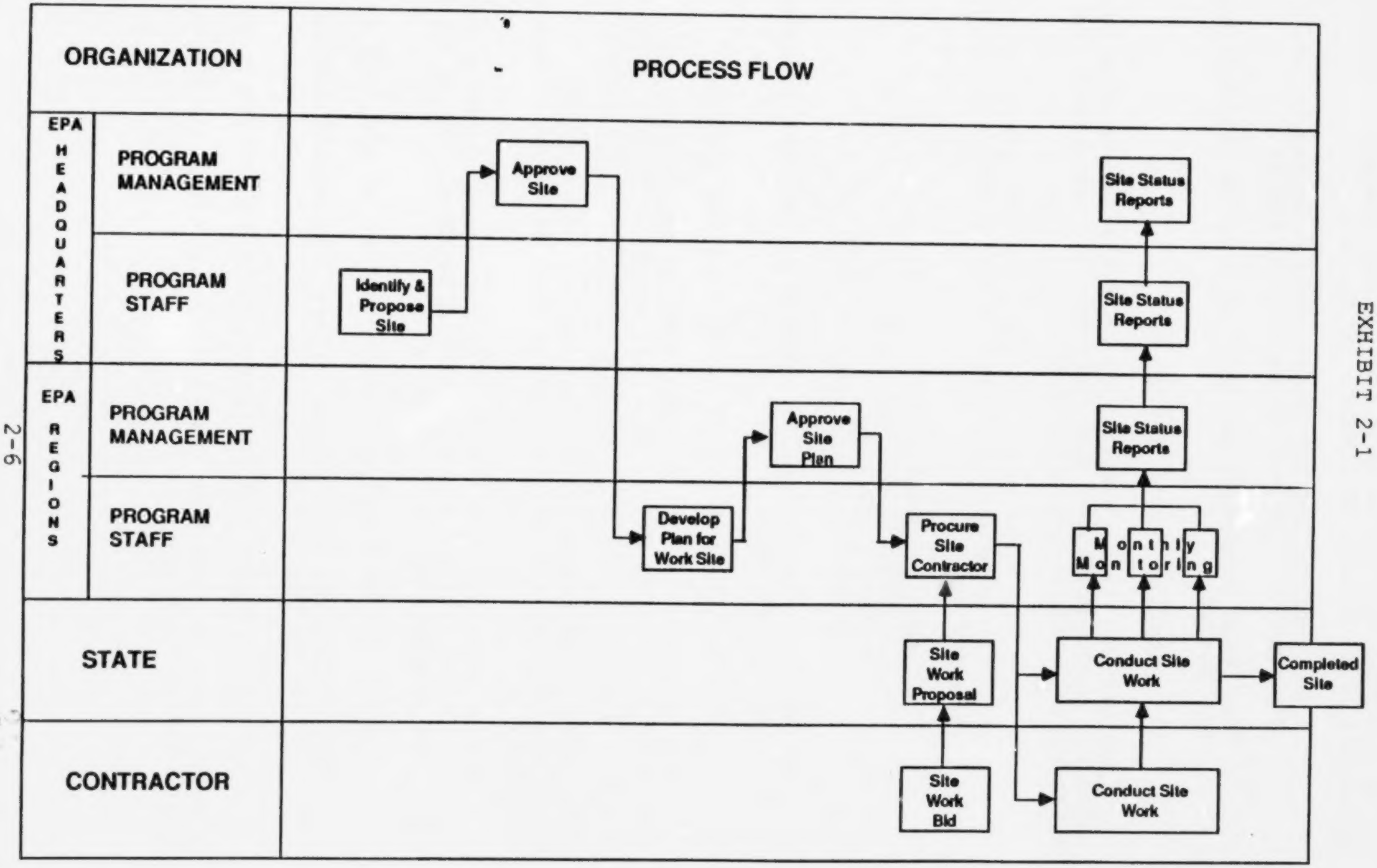
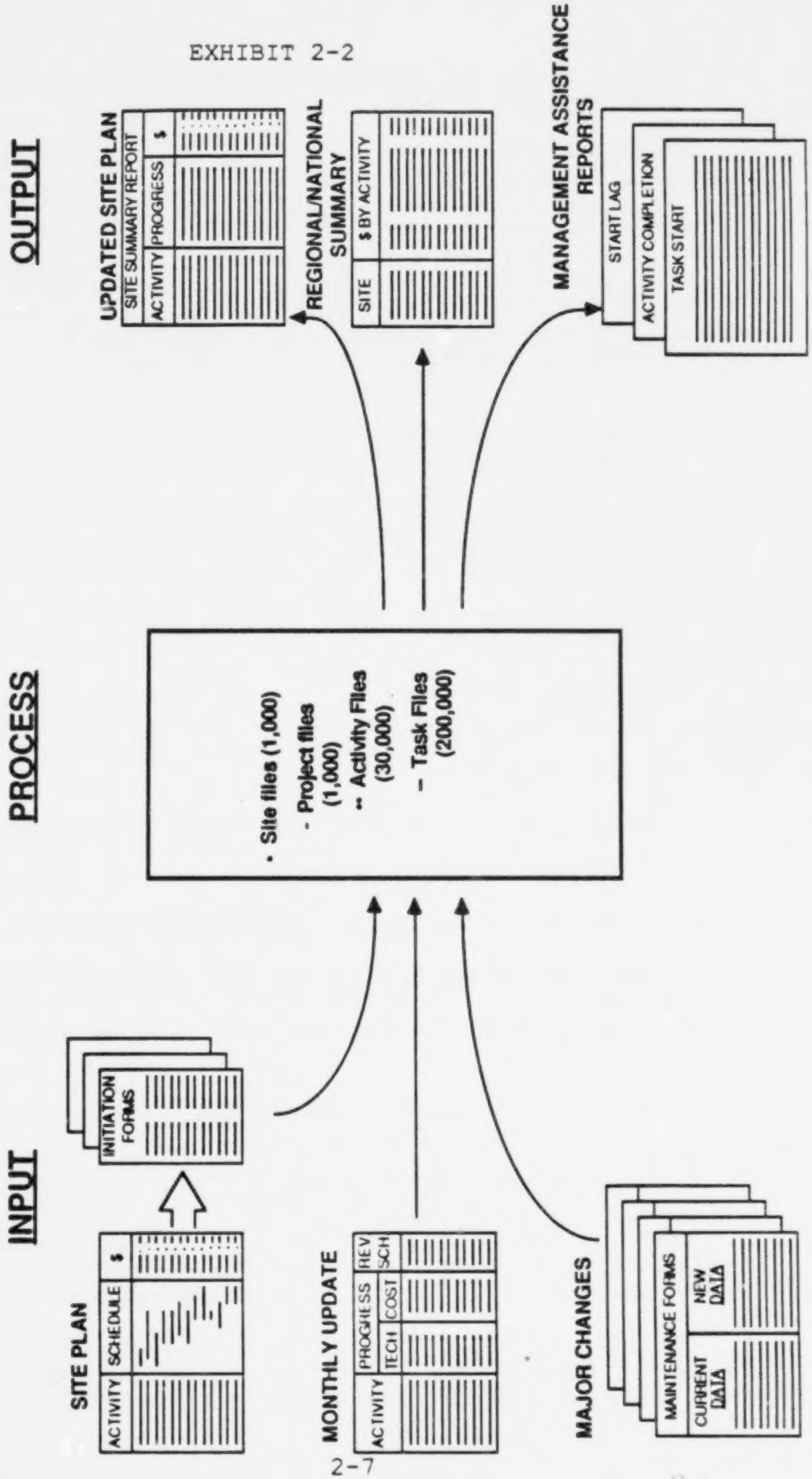

ORGANIZATION
PROCESS FLOW
EPA HEADQUARTERS
PROGRAM MANAGEMENT
PROGRAM STAFF
EPA REGIONS
PROGRAM MANAGEMENT
PROGRAM STAFF
STATE
CONTRACTOR
Identify & Propose Site
Approve Site
Develop Plan for Work Site
Approve Site Plan
Procure Site Contractor
Site Work Proposal
Site Work Bid
Conduct Site Work
Conduct Site Work
Monthly Monitoring
Site Status Reports
Site Status Reports
Site Status Reports
Completed Site

EXHIBIT 2-2

INITIAL SYSTEM CONCEPT - SITE MANAGEMENT SYSTEM


INPUT
SITE PLAN
ACTIVITY
SCHEDULE
$
INITIATION FORMS
MONTHLY UPDATE
ACTIVITY
PROGRESS
TECH
COST
REV
SCH
MAJOR CHANGES
MAINTENANCE FORMS
CURRENT DATA
NEW DATA
PROCESS
• Site files (1,000)
- Project files (1,000)
•• Activity Files (30,000)
– Task Files (200,000)
OUTPUT
UPDATED SITE PLAN
SITE SUMMARY REPORT
ACTIVITY
PROGRESS
$
REGIONAL/NATIONAL SUMMARY
SITE
$ BY ACTIVITY
MANAGEMENT ASSISTANCE REPORTS
START LAG
ACTIVITY COMPLETION
TASK START

2.3 STEP 3 - EVALUATION AND TESTING OF THE INITIAL SYSTEM CONCEPT THROUGH USER REVIEW

Documentation of processes and functions as outlined in Steps 1 and 2 will result in a high level Initial System Concept depicting system inputs, processes and outputs. During this step, the system concept is evaluated in terms of output usefulness, input feasibility and possible constraints. A methodology which should be employed for evaluating system usefulness is to review the system concept as well as "mock-ups" of system outputs (hard copy or screens) with users or potential users. The "mock-ups" allow potential users to visualize the output of the system with three results:

- The user is able to "relate" to the output and indicate the benefit (or lack of benefit) of the output
- The discussion surrounding the reports can often identify other types of needs or report designs which can be incorporated into the Initial System Concept
- A preliminary estimate of the benefit to the user or potential user can be made by the user.

During the review of the system concept and outputs with users, an exploration of possible constraints to the system design should also be conducted. Constraints and/or implementation problems may include:

- Resistance by managers or staff to changes in operations
- Organizational impediments
- Input data compilation/collection problems
- Lack of hardware accessible to the organizational units
- Lack of staff and/or funds to develop and/or operate a system
- Information security needs and considerations based on the sensitivity of the system
- Limited development time.

Also, during the system concept review, the proposed output reports can be expected to be partially redesigned in response to suggestions and reactions to individual reports by the users.

Finally, it is at this point that system options or process designs for achieving similar outputs can be explored with the user. Although the options analysis is not fully conducted until a later phase of the system development life cycle (described in Volume B), it is useful to begin identifying alternatives with the user during this phase.

Two results should emerge from this step of the Mission Needs Analysis:

- A refined Initial System Concept incorporating the results of user evaluations of both the concept and proposed outputs
- An initial assessment of the system feasibility, priorities and constraints.

These and the results from the previous step provide the basis for documenting each section in the Mission Needs Statement (EEI-1).

2.4 STEP 4 - FINAL SPECIFICATION AND DOCUMENTATION OF RESULTS IN THE MISSION NEEDS STATEMENT

The next step in conducting the Mission Needs Analysis is the formal documentation of the work performed in Steps 1 through 3 in a Mission Needs Statement. This document need not be long. An outline for this document is attached in Appendix A. As shown, primary chapters in the statement include:

- A background section, with a concise statement of the problem. It should also relate the problem and its solution to the agency organizational unit's missions and functions.
- An Information Flow/Initial System Concept section which contains the Initial System Concept and also identifies:
  - Input data sources
  - Macro information flow and functions
  - System outputs including "mock up" format
- A discussion of potential system development constraints.

The actual length of the Mission Needs Analysis document is dependent on various factors such as: complexity of the problem or the organizational functions and mission, the size or scope of the Initial System Concept, the impact of any known elements of risk, and the number and effect of potential constraints to development and implementation.

2.5 STEP 5 - INITIATION OF THE PROJECT MANAGEMENT PLAN

The final step in conducting the Mission Needs Analysis is to initiate a preliminary Project Management Plan. The format of the Project Management Plan is contained in Volume B, Preliminary

Design and Options Analysis. It is important to start this planning effort as early as possible in order to plan and schedule the resources required for the activities that follow. This preliminary document should include the following:

- Steps and tasks associated with Preliminary Design and Options Analysis
- Assignment of roles and responsibilities for the purpose of accountability
- Resource allocations to accomplish the Preliminary Design and Options Analysis
- Project costs and time frames associated with Preliminary Design and Options Analysis.

At this stage of the system development process, there should also be little, if any, thought given to the specific hardware or software that is to be used to support the system. Options in these areas will be considered as part of the options analysis which is discussed in Volume B.

3. SUMMARY

3.1 MISSION NEEDS ANALYSIS OUTPUTS

The outputs, documents and results of the Mission Needs Analysis are as follows:

- EEI-1, Mission Needs Analysis, is a concise document that describes the problem and the need to perform the process or function in support of the organization's mission.
- An "Initial System Concept" indicating the flow of information required to support the function, as well as the preliminary input documents and output reports.
- An initial Project Management Plan that outlines the tasks, resources and deliverables of the next phase of the project effort.

3.2 NEXT STEPS

Once the Mission Needs Statement is complete, it should be understood that it will continue to evolve and change as the "Initial System Concept" proceeds through the development life cycle. The next major step is to prepare the Preliminary Design and Option Analysis as described in detail in Volume B. Both of these tasks are based on information collected during the Mission Needs Analysis and embodied in the "Initial System Concept."

APPENDIX A
ESSENTIAL ELEMENTS OF INFORMATION

APPENDIX A

ESSENTIAL ELEMENTS OF INFORMATION

A. ESSENTIAL ELEMENTS OF INFORMATION

This appendix provides a representative outline of the document that will be developed during the Mission Needs Analysis phase.

A.1 INTRODUCTION

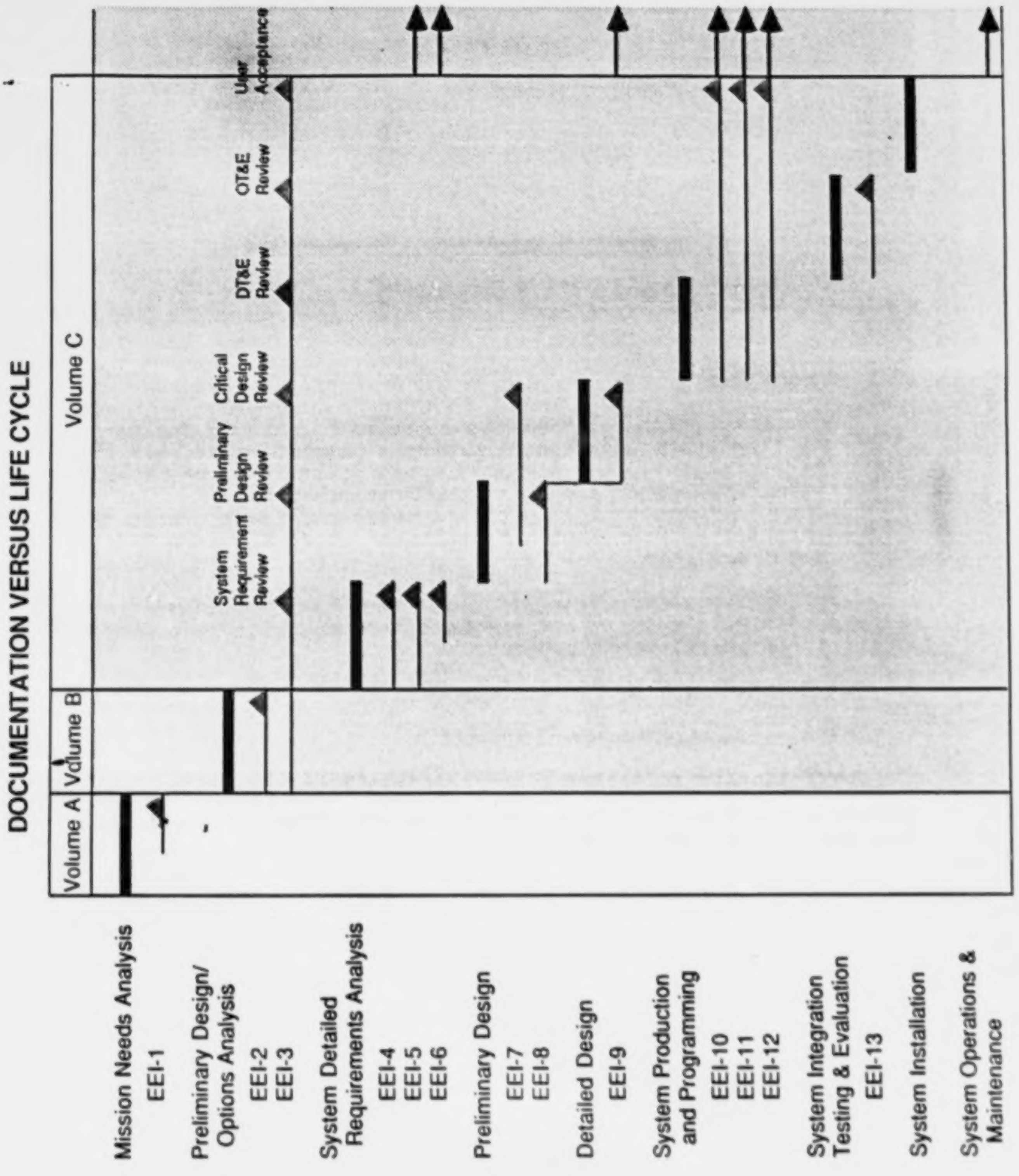
The documentation requirements contained in this appendix apply to all software development projects, regardless of size, complexity or origin. At a minimum, these standards apply to all new software development projects. Maintenance and/or enhancements to existing information systems must comply with the requirements set out in Chapter 1, section 1.5 of Volume A, Mission Needs Analysis.

Compliance with the standards and conventions provided in this appendix will ensure that adequate documentation is produced for all system development projects.

The document defined in this appendix is:

EEI-1 • • Mission Needs Statement

The following milestone chart illustrates the relative initiation and completion of each document with respect to the software development life cycle, its major phases, and the span and scope of Volumes A, B, and C.



DOCUMENTATION VERSUS LIFE CYCLE

Volume A
Volume B
Volume C
System Requirement Review
Preliminary Design Review
Critical Design Review
DT&E Review
OT&E Review
User Acceptance
Mission Needs Analysis
EEI-1
Preliminary Design/ Options Analysis
EEI-2
EEI-3
System Detailed Requirements Analysis
EEI-4
EEI-5
EEI-6
Preliminary Design
EEI-7
EEI-8
Detailed Design
EEI-9
System Production and Programming
EEI-10
EEI-11
EEI-12
System Integration Testing & Evaluation
EEI-13
System Installation
System Operations & Maintenance

EEI-1. MISSION NEEDS STATEMENT

1. BACKGROUND

- Agency and organizational mission requiring system support
  - Mission/function statement(s)
  - Organizational chart with key functions/users identified
  - Operational environment
  - Current system description, including manual procedures
- Evolution of system need
  - New program or functions, or
  - Current performance mode and limitations/problems

2. INFORMATION FLOW AND INITIAL SYSTEM CONCEPT

- Description/documentation of information flow including:
  - Organizational process flow charts
  - Key input processes/documents
  - Primary data integration/data base functions and processes
  - Key output report types and distribution
- "Mock-ups" of key output reports and discussion of their benefits to users
- Initial System Concept (ideally one page) and related description

3. DEVELOPMENT/OPERATIONAL CONSTRAINTS

- User commitment, priority, discipline and budgetary limitations
- Policy or organizational constraints
- Information security needs based on system sensitivity
- Timing of need
- Interface needs
- Stability/flexibility of need

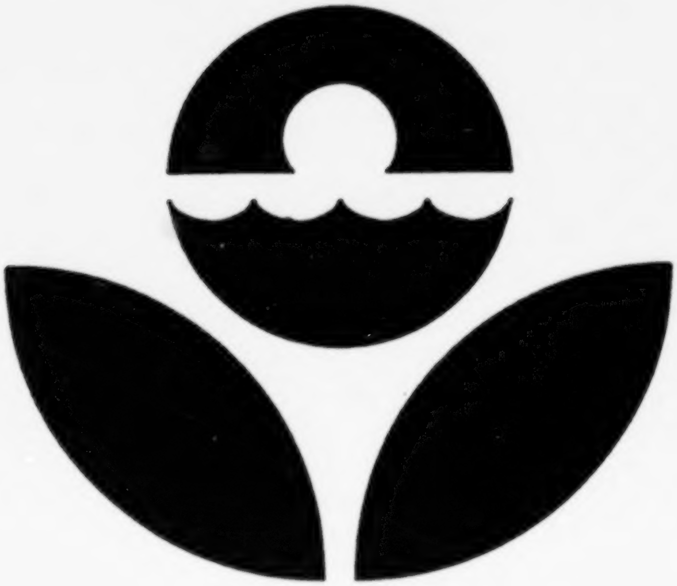
EPA
United States
Environmental Protection
Agency

Office of Information
Resources Management
Washington DC 20460

OIRM 87-02B
10/87

EPA SYSTEM DESIGN & DEVELOPMENT GUIDANCE:

VOLUME B: PRELIMINARY DESIGN AND OPTIONS ANALYSIS



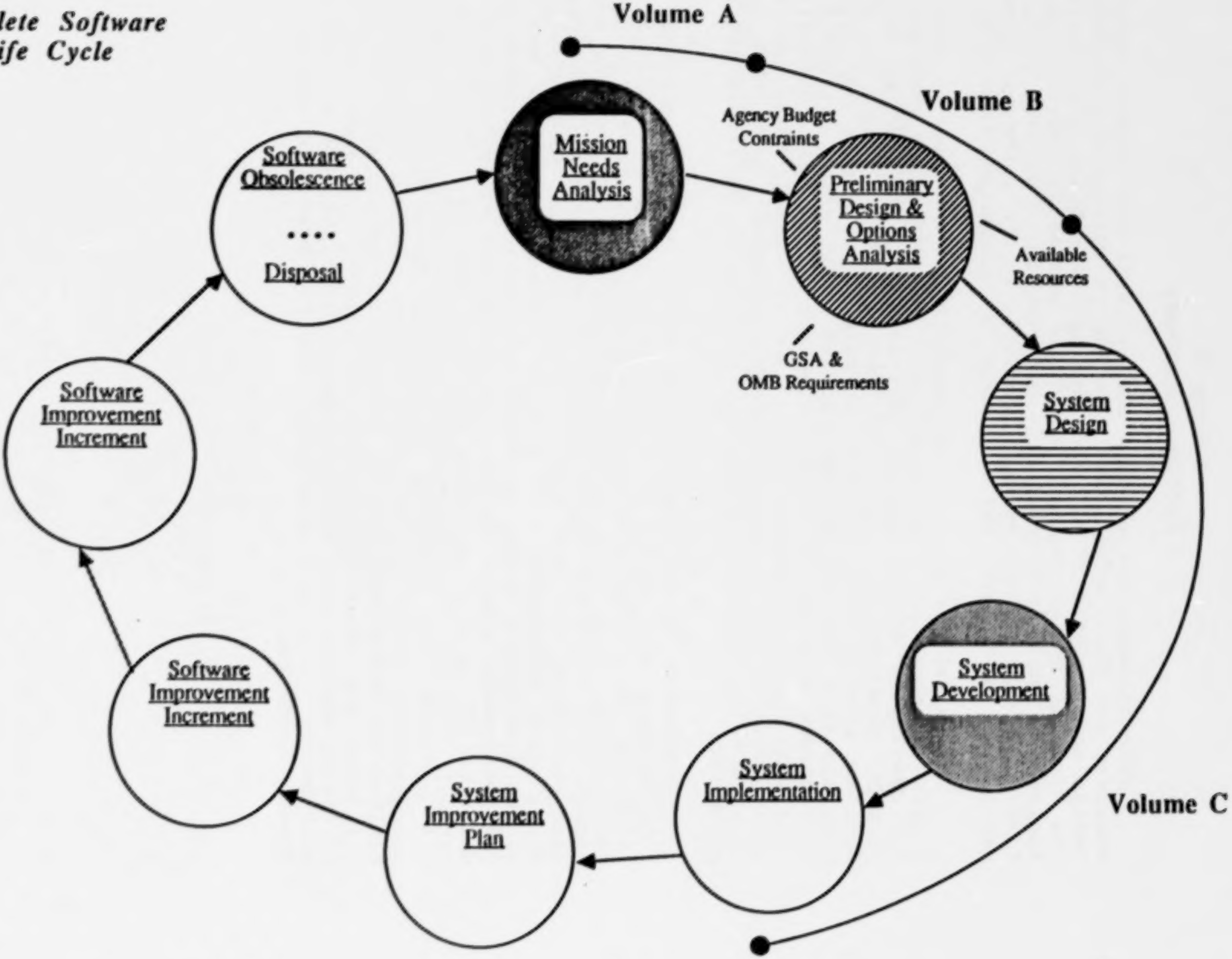
Volume B
Executive Summary

This document establishes the criteria that Agency program managers and their staff should follow to develop a preliminary design and analysis of all the alternative options that satisfy the "Initial System Concept" developed during the Mission Needs Analysis. The objective of this document is to provide guidance towards satisfying requirements specified in EPA's IRM Policy Manual for the acquisition and management of information technology.

The guidelines within this document are designed to provide program managers and their staff with guidance and a methodology for developing design options that satisfy the "Initial System Concept" developed as a result of the processes in Volume A. This document also provides guidance for selecting the most cost-effective solution for the defined problem. The steps described in this volume will result in the selection of the most cost-effective mission based option (manual or automated) based on life cycle concepts and an initial project management plan that outlines how the selected option will be defined, developed and implemented.

Completion of the steps and subsequent analysis outlined in this document will result in a list of two or more feasible solutions for the problem and related documentation concerning their descriptions, life cycle benefits and costs, a formal life cycle benefit-cost analysis, and a summary of the risks and contingencies associated with each option. After selecting an alternative, the project management plan will be updated to reflect how the system development effort will be accomplished. The revised project management plan will focus on resources, scheduling and accountability as well as other pertinent factors. The following exhibit describes the complete software life cycle. Each phase in the software life cycle is represented by a circle with its corresponding title on the inside of the circle. Inputs to the Preliminary Design and Options Analysis or factors that influence the phase are shown surrounding the circle. As indicated, influencing factors are: agency budget constraints, GSA and OMB requirements, available resources, and the preceding phase, the Mission Needs Analysis.

Complete Software Life Cycle


Volume A
Volume B
Volume C
Mission Needs Analysis
Agency Budget Contraints
Preliminary Design & Options Analysis
Available Resources
GSA & OMB Requirements
System Design
System Development
System Implementation
System Improvement Plan
Software Improvement Increment
Software Improvement Increment
Software Obsolescence
....
Disposal

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1. INTRODUCTION

Pursuant to the Environmental Protection Agency's IRM Policy Manual, this volume is the second of three volumes which provide guidance for Agency system design and development efforts. This volume provides guidance for the second phase of the EPA system development process -- Preliminary Design and Options Analysis.

Volume B is to be used by Agency Program and Management Officials and responsible staff to identify alternative manual and system solutions to problems identified in the Mission Needs Analysis, and to select the best solution based upon life cycle benefit-cost analysis principals.

1.1 BACKGROUND

The Environmental Protection Agency expends millions of dollars each year on the design, development, implementation and maintenance of major environmental and administrative systems vital to EPA's programs and administrative functioning. Management of these system resources is becoming increasingly complex, since the rapid development of information technology in the 1980's has dramatically increased computer capacity and user accessibility. The result has been two-fold:

- An increasing number of system development efforts by managers and staff at all organizational levels who, because of access to their own equipment, develop their own systems independently of Agency systems staff
- A wide range of hardware/software options for implementation of any specific system concept or design.

Therefore, there has been a proliferation of system development efforts by a broad range of users with varying levels of sophistication in making system development decisions and conducting system development efforts.

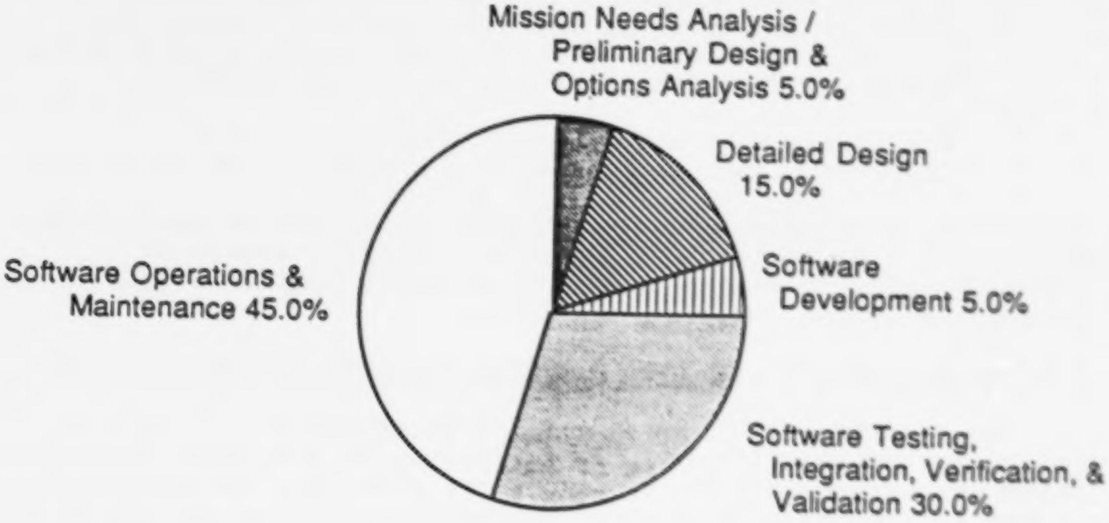
1.2 OBJECTIVES OF THE SYSTEM DESIGN AND DEVELOPMENT GUIDANCE

Within EPA's Office of Administration and Resources Management (OARM), the Office of Information Resources Management (OIRM) is responsible for ensuring the effective and efficient use of EPA's information resources including automated system design, development and maintenance. OIRM's objective in this endeavor is to provide guidance, assistance, and only when necessary, controls, to assure that the Agency's considerable information resources are utilized cost-effectively for the overall benefit of the Agency. To this end, OIRM has developed umbrella policies guiding information system development and acquisition (see Information Resources Management Policy Manual) and has also developed a three-volume set of guidelines and standards to assist with EPA's system development efforts. These three volumes provide sequential guidance for:

- Defining the system requirement (or need) and related operating concept
- Developing feasible system options and selecting the most cost-effective option
- Designing, developing and implementing the selected system option.

Exhibit 1-1, following this page, graphically depicts the three major phases of the system development life cycle and the decisions and results expected of each phase. However, EPA's system development life cycle discussed in these volumes represents little more than fifty-five percent of the total life cycle of a software application. Typical cost allocations for each major component of the total system life cycle are represented in the graph below.

Life Cycle Costs [1]



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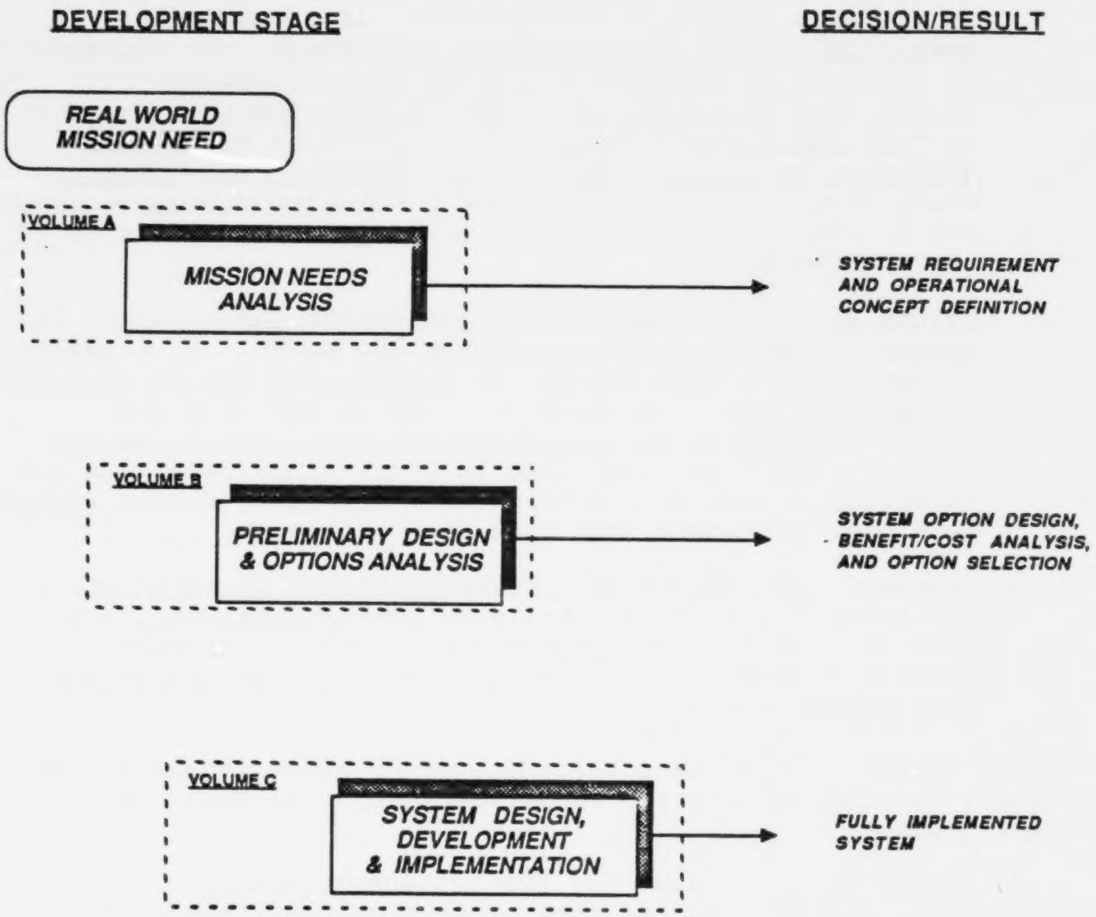
[1] These figures are based on a graphic illustration in Controlling Software Products by Tom DeMarco, 1982, which purports to represent industry averages.

EXHIBIT 1-1

EPA SYSTEM DEVELOPMENT LIFE CYCLE & DECISION PROCESS


DEVELOPMENT STAGE
DECISION/RESULT
REAL WORLD MISSION NEED
VOLUME A
MISSION NEEDS ANALYSIS
SYSTEM REQUIREMENT AND OPERATIONAL CONCEPT DEFINITION
VOLUME B
PRELIMINARY DESIGN & OPTIONS ANALYSIS
SYSTEM OPTION DESIGN, BENEFIT/COST ANALYSIS, AND OPTION SELECTION
VOLUME C
SYSTEM DESIGN, DEVELOPMENT & IMPLEMENTATION
FULLY IMPLEMENTED SYSTEM

This document is the second of the three-volume set. The three volumes cover the following:

- Volume A - Mission Needs Analysis -- is designed to provide program managers and staff with a suggested methodology for assessing and evaluating the need (requirement) for an information system. Applying the methodology in this volume will result in two outputs: 1) a preliminary specification of the management requirement for information or information processing and the outputs and benefits tied to the user organization's mission and operations, and 2) an "Initial System Concept" which provides an initial depiction of the system's input, processes and outputs. These results: 1) confirm that a need (requirement) exists and 2) provide a preliminary operational specification of the requirement.
- Volume B - Preliminary Design and Options Analysis -- is directed towards program managers and staff. It provides guidance and a methodology for structuring design options for meeting the requirement defined in Volume A and provides guidance for selecting the most cost-effective option. The steps described in this volume result in the selection of the most mission/cost-effective option (manual or automated) based upon life cycle concepts.
- Volume C - System Design, Development And Implementation -- is intended for use primarily by system developers and provides specific guidance and standards which must be adhered to when undertaking automated system design and development efforts.

Together these three volumes provide comprehensive guidance and standards for the orderly and cost-effective development of automated systems.

It should be noted that the EPA has established a comprehensive information security program through Chapter 8 of the IRM Policy Manual. Because retrofitting security measures into software under development is complex, expensive and risky, security considerations need to be an integral part of the system development life cycle. Consequently, security issues and factors are identified at appropriate points throughout these volumes. A detailed discussion of security design and development considerations is beyond the scope of this guidance. Additional security guidance will be provided in the forthcoming EPA Information Security Manual.

1.3 AUTHORITY

The EPA System Design and Development Guidance derives its authority from Chapter 4 of the IRM Policy Manual, entitled "Software Management," which establishes the Agency Software Management Program. The guidance serves as the primary guidance for Agency system design and development efforts.

1.4 APPLICABILITY OF THE GUIDANCE

Senior Agency managers and responsible staff should read the guidance and become familiar with the decision-making process involved with system design and development efforts. They are responsible for ensuring adequate analysis and documentation to support the critical decisions/results illustrated in Exhibit 1-1. The full documentation requirements for automated system development efforts, which must be followed to conform to OARM policy, are fully discussed in Volume C.

In general, Volumes A and B are intended to assist program offices and/or users in conducting their own initial studies of management requirements, needs, option feasibility and cost-effectiveness. In this context, the term "system" in Volumes A and B refers to a systematic set of processes and/or procedures which can be used to meet the information needs of a user. It does not imply that the "system" will be an automated system.

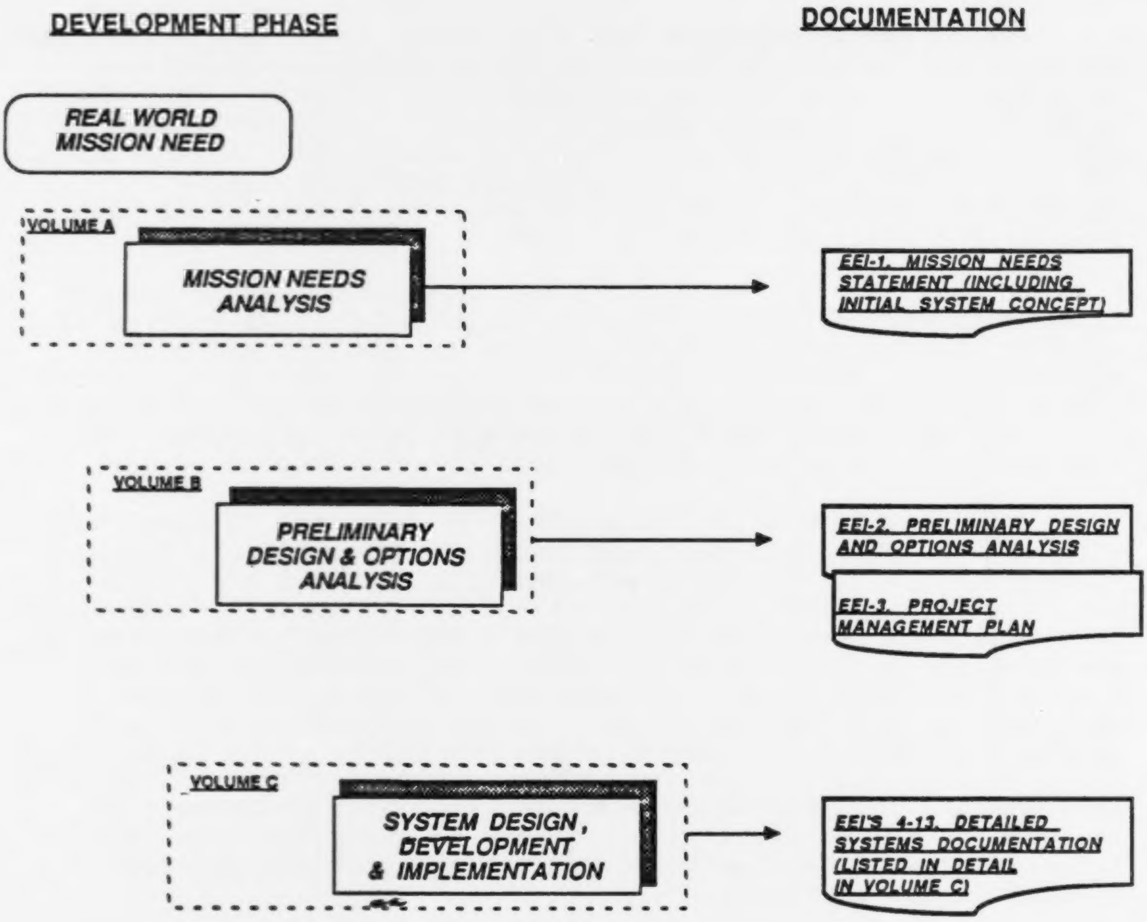
Volume C, however, presumes that an automated or partially automated solution has been selected as a result of the Volume B options analysis. Volume C provides both guidance and standards for automated system development efforts. If the automated system is a relatively small application on a microcomputer targeted for use within a single office (a "user owned information system"), Volume C provides simplified requirements for system design, development, and implementation. If the proposed system is a larger application (mainframe or minicomputer), which is mission-critical or involves multiple offices and organizations, Volume C provides the full set of guidance and standards which must be followed by system developers. This will assure uniform, cost-effective system development in accordance with EPA policies, guidelines and standards.

1.5 DOCUMENTATION REQUIREMENTS

In general, the intent of the three volume System Design and Development Guidance is to provide a consistent focus for system development efforts which will allow both EPA program managers and OARM managers to cost-effectively develop and maintain the Agency's systems. To achieve this goal, certain documentation requirements must be met. Exhibit 1-2, following this page, summarizes the EEI (termed "Essential Elements of Information" (EEI) documents) documentation requirements. As shown,

EXHIBIT 1-2

EPA SYSTEM DEVELOPMENT LIFE CYCLE DOCUMENTATION


DEVELOPMENT PHASE
DOCUMENTATION
REAL WORLD MISSION NEED
VOLUME A
MISSION NEEDS ANALYSIS
EEI-1. MISSION NEEDS STATEMENT (INCLUDING INITIAL SYSTEM CONCEPT)
VOLUME B
PRELIMINARY DESIGN & OPTIONS ANALYSIS
EEI-2. PRELIMINARY DESIGN AND OPTIONS ANALYSIS
EEI-3. PROJECT MANAGEMENT PLAN
VOLUME C
SYSTEM DESIGN, DEVELOPMENT & IMPLEMENTATION
EEI'S 4-13. DETAILED SYSTEMS DOCUMENTATION (LISTED IN DETAIL IN VOLUME C)

documentation required for the first two phases of the process -- Mission Needs Analysis and the Preliminary Design and Options Analysis -- are limited to one and two documents, respectively. All system development efforts are subject to the documentation requirements of these first two phases as set out in Volumes A and B.

If a full information system development effort is anticipated after the first two phases, then a traditional series of system design and development documents must be developed and submitted as shown in Exhibit 1-2.

For certain system development efforts OIRM and office Senior Information Resources Management Officials (SIRMOs) must be involved in a review capacity to fulfill EPA's IRM Policy Manual requirements. Systems falling into one or more of the following categories must have OIRM/SIRMO review involvement:

- EPA mission critical
- States, local governments or other Federal agencies involved
- Interorganizational involvement (e.g., between Assistant Administratorships or including Regional Office involvement)
- Costs for system development/enhancement are projected to exceed $250K (excluding costs associated with long-term system operation and maintenance)
- Information security issues involving the three general security areas: applications security, installation security and personnel security. In total, information security involves the precautions taken to protect the confidentiality, integrity and availability of information
- Privacy Act or confidential business information involved.

For system development efforts falling into any one of these categories, OIRM and office SIRMOs must be involved beginning with a review of EEI-1, generated at the conclusion of the Mission Needs Analysis, as described in Volume A of the EPA System Design and Development Guidance. OIRM/SIRMO review involvement will continue through the development life cycle of these systems and will include all EEI documentation requirements for such systems.

For systems not falling into one of the above categories, EEIs may be forwarded to OIRM/SIRMOs for information and review as they are developed.

Automated systems involving information security will be subject to one additional documentation requirement -- completion of a certification form (certification of sensitive systems is an OMB requirement). The form, which is under development and will be issued as part of the forthcoming EPA Information Security Manual, will capture basic information on system sensitivity, security requirements, security design, reviews, test scenarios, results and safeguards. Information needed to complete the form will be readily available in the EEI documentation. Prior to the system being placed into use or production, the cognizant SIRMO (or other senior official in the AA/RA's office) will need to certify that the automated system is adequately safeguarded based on the information in the form.

It is not OIRM's intent to burden EPA managers with a host of documentation requirements for each system development effort. The EEIs simply stress typical documentation requirements and their outlines highlight major topics that need to be considered for any system development effort. Managers may use their professional judgment in substituting, combining, or down-scaling the content of the EEIs to meet the unique requirements of their project. Additionally, the EEIs set out in this volume are not meant to conflict with or add more burden to documentation requirements set out in other manuals (e.g., EPA/NCC ADABAS Application Development Procedures Manual). Documentation produced according to such other procedures will invariably satisfy, either partially or fully, some EEI requirements.

Criteria for determining the minimum EEI documentation for a specific system during the design, development and implementation phase is based on the nature and scope of the information system and its importance to EPA's mission. Four types of systems with differing levels of EEI documentation requirements are identified as follows:

- Major Agency Information System: An information system that requires special continuing management attention because of its importance to an Agency mission; its high development, operating, or maintenance costs or its significant impact on administration of Agency programs.
- Widely Accessed Information System: An information system that is not a Major Agency Information System (although it significantly supports accepted program goals and missions) but is widely accessed by a combination of EPA Headquarters, Regional Offices and/or State and local users and other Federal agencies.
- Localized Information System: An information system that is not a Major Agency Information System but significantly supports accepted program goals and missions and is

accessed primarily by users in one major area, e.g., EPA Headquarters, a single Agency program, or a Region.

- User Owned Information System: Unique, stand-alone system developed to improve the efficiency or effectiveness of operations for a single user or a small group of users.

Documentation requirements for each of these system categories are projected in Exhibit 1-3 on the next page and in Chapter 4 of Volume C. Policies and procedures covering the submission, review and approval of EEIs by OIRM will be issued under separate guidance.

1.6 ASSISTANCE AND SUPPORT AVAILABLE

Agency Program and Management officials embarking on a system development effort should be aware that there are at least two sources available to them for assistance and support during the system development life cycle:

- Within each AA/RA's office SIRMOs are available for assistance, support and guidance relative to the EPA Systems Design and Development Guidance and other OIRM guidance and standards (e.g., Core Systems, Structured Programming, etc.)

- OIRM, with its general IRM management oversight role and requirement to exercise procurement approval authority, has a staff organized to support EPA's administrative, program and research communities.

It is appropriate to involve these support sources as early as is feasible in the system development life cycle for most system development efforts.

The primary reasons for early involvement of SIRMOs and OIRM staff are:

- Fulfilling EPA's IRM policy for system development review requirements

- Providing a value-added service role involving consultation, assistance, technical standards, guidance and interpretation of requirements

- Expediting procurement for system development efforts which proceed to the system design, development and implementation phase

- Providing assistance in determining user needs as early as possible in the life cycle.

EXHIBIT 1-3

SYSTEM CATEGORY /EEI MATRIX

EEI Requirements / System Category	Systems That Require OIRM Involvement[1]	Major Agency Information Systems	Widely Accessed Information Systems	Localized Information Systems	User Owned Information Systems
EEI-13 **System Integration Test Report**	●	●	●	●	
EEI-12 **Software User's Reference Guide**	●	●	●	●	●
EEI-11 **Software Operations Document**	●	●	●	●	●
EEI-10 **Software Maintenance Document**	●	●	●	●	●
EEI-9 **Software Detailed Design Document**	●	●	●	●	●
EEI-8 **Software Preliminary Design Document**	●	●	●		
EEI-7 **Software Test and Acceptance Plan**	●	●	●		
EEI-6 **Software Management Plan**	●	●	●		
EEI-5 **System Detailed Requirements Document**	●	●	●	●	●
EEI-4 **System Implementation Plan**	●	●	●	●	
EEI-3 **Project Management Plan**	●	●	●	●	
EEI-2 **Preliminary Design and Options Analysis**	●	●	●	●	
EEI-1 **Mission Needs Analysis**	●	●	●	●	●

[1] As detailed on page 1-7

Achieving these objectives will strengthen EPA's system development efforts and avoid major pitfalls that have beset system development efforts in other government agencies (e.g., project stalls due to outyear funding shortages stemming from under-projected planning or project disruptions due to failure to get hardware/software acquisitions into the procurement cycle expeditiously and when required).

The remainder of Volume B provides guidance for conducting the second phase of the system development process -- the Preliminary Design and Options Analysis phase.

2. PRELIMINARY OPTIONS DESIGN

Completion of the Mission Needs Analysis phase of the system development process will have resulted in development of an Initial System Concept (operational concept) meeting the identified management and functional requirements of the organization. The purpose of Volume B is to translate these requirements into operational specifications, to identify and develop feasible options meeting the requirements and to analyze the overall feasibility and cost-effectiveness of the various options. This chapter presents the methodologies for:

- Translation of the management and functional requirements identified during the Mission Needs Analysis into operational specifications

- Identifying and developing procedural and system options satisfying the defined management and functional requirements and operational specifications.

It should be noted that requirements refinement and system option definition is an iterative process in that management and functional requirements are first translated into operational specifications. System options are then developed to satisfy (insofar as possible) the management requirements and then the operational specifications are refined. The result of this iterative analytic process is a set of two to four feasible design options, which to varying degrees may meet the basic defined management and functional requirements identified in the Mission Needs Analysis.

2.1 TRANSLATING MANAGEMENT AND FUNCTIONAL REQUIREMENTS INTO OPERATIONAL SPECIFICATIONS

The Mission Needs Analysis of Volume A broadly defines the system management and functional requirements and results in development of the macro-level Initial System Concept. The purpose of this stage is to further examine and define the current system environment and user needs, then to translate these needs into a specific set of operational specifications. The result of this step is a set of operational specifications which provide a basis for structuring combined automated/manual options meeting the management and functional requirements defined in Volume A. The objective is to develop the operational specifications only in sufficient detail to allow defining of options for a proposed system, but not to complete a detailed system requirements analysis. The operational specifications form the baseline for what a proposed system must do. The detailed system requirement analysis is conducted in Phase III (only if an automated system solution is selected) and is discussed in Volume C.

The operational specification process focuses first on defining and providing details about specific operational parameters which are required to meet the management requirement. These include:

2.1.1 System Inputs

- Origin/type of input (indirect data entry from forms, interface with other automated systems, etc.)

- Frequency/rate of input (hourly, daily, weekly, monthly, etc.)

- Volume of data/text

2.1.2 System Functions/Processes

- Process and flow of each input into the "system"

- Data processing/manipulation/tabulation functions

- Types and sizes of major data files

- Update/purging requirements

- Statistical or scientific analysis requirements

- Special functions such as project management/critical path, etc.

2.1.3 System Outputs

- Hard copy report formats
- Screen display
- Special presentations/graphics
- Frequency (daily, weekly, monthly, on demand) and ongoing output rate
- Other system interfaces
- View locally and/or transmit to remote locations

2.1.4 General System Requirements

- Required system/user interface
- Information security requirements, including:
  - Accuracy and validity requirements
  - Criticality of key outputs
  - Failure contingency
  - Access controls
  - Response time
  - Flexibility

- Failure contingency

In general, these specific operational specifications involve an elaboration and quantification of the Initial System Concept developed during the Mission Needs Analysis. All operational specifications should be designed to meet the management and functional requirements identified in the Mission Needs Analysis. Concentration at this point of the study should be on creating a detailed picture of the way in which inputs/processes/outputs are generated and used. Detailed formats and information field structuring will be established in the System Design stage described in Volume C.

2.2 DEVELOPING FEASIBLE SYSTEM OPTIONS

The operational specifications defined above provide the foundation for structuring two to four feasible system options which largely (but probably not exactly) meet the management and functional requirements. In general, there are almost always a number of potential options for meeting the management and functional requirements varying from manual processes through sophisticated automated system designs. It is generally true that, if only one way to solve a problem is apparent, the management problem has not been adequately defined and analyzed. Options should include feasible approaches to solving the management problem and should not be limited to alternatives involving automation (see FIRMR 201-30.009, "Analysis of Alternatives for Satisfying a Requirement.")

Structuring and developing possible options to satisfy the mission need (management requirement) and operational specifications is a process which involves several activities performed simultaneously and iteratively. They include:

- Determining the flexibility and relative priority of each of the operational specifications

- Reviewing the range of available hardware and software options available to meet the specifications

- Constructing alternatives by structuring/adjusting the operational specifications and related procedures to meet available hardware and software options

- Option refinement through balancing overall management requirements with development costs and timing considerations.

These four steps are pursued iteratively to first structure and then specify in some detail the system options.

2.2.1 Determining the Flexibility and Relative Priority of Each of the Operational Specifications

At this stage, the operational specifications identified earlier are treated as somewhat flexible and not a rigid set of specifications that every systematic solution must meet. Instead, the management and functional requirements should be considered as the overall goal but determinations must be made regarding the relative priority of various requirements and specifications. To assist the system developer with this process, a flexibility/priority analysis of each of the requirements and specifications should be performed in order to define the ranges of associated parameters. This analysis represents just another step in the iterative process of structuring system options. The flexibility/priority analysis is conducted based upon the overall management and functional requirements and the operational specifications defined in Section 2.1. Exhibit 2-1 provides an example of an analysis of the flexibility of inputs/outputs for a grants payment process. The analysis provides a "flexibility assessment" on key components of the requirements and operational specifications developed earlier. Conducting this analysis provides the system developers with a sense of the way in which the requirements and specifications must be satisfied including which things are mandatory, and which are desirable. The results of this "feel" of relative priorities is used both for the development of options and for the options selection process.

2.2.2 Reviewing the Range of Hardware and Software Potentially Available to Satisfy the Initial System Concept (Management And Functional Requirements) and Operational Specifications

During this step of the system development process, a preliminary review of the hardware and software potentially available for the application should be conducted. The past several years have seen a major expansion in the range of hardware and software available to potential users. Thus, this step of the system development process has become more critical as the range of options has increased. In conducting this review it is strongly urged that EPA's Office of Information Resources Management and/or the Senior Information Resource Management Officer (SIRMO) for the program area be contacted for assistance.

The range of hardware and software currently available in EPA is briefly summarized in Exhibit 2-2. This list provides an initial basis for determining available options within the Agency environment. In addition, however, the system developer, in conjunction with OIRM or SIRMO staff, might want to review and consider other kinds of specialized hardware/software for particular systems.

EXHIBIT 2-1

TYPICAL FUNCTIONAL REQUIREMENTS ANALYSIS WORKSHEET, INPUT/OUTPUT FLEXIBILITY OF GRANTS PAYMENT PROCESS

	COMPONENT		COMMENTS ON FLEXIBILITY
			INPUT
1.	Grant authorization form	1.	Form must have entries in all blocks conforming to predefined ranges with 100% edit check.
2.	Invoice	2.	Must have date, amount, grantee name, address, and grant authorization number and must be 100% edited and verified.
			PROCESS/FUNCTION
1.	Ledger	1.	Must be accurate, be backed up, and all incoming transactions must have been 100% edited and verified
2.	Check Printing	2.	Must be accurate, be backed up, provide for safeguards and anti-counterfeit procedures, and allow 100% edit and verification.
			OUTPUT
1.	Funding check for each program operation	1.	Checks issued must be 100% accurate and delivered to grantees by 15th of each month
2.	Updated ledger	2.	Must be 100% accurate and be completed by 13th of month so that checks can be run by 15th
3.	Management Report A	3.	User would like by 15th but indicates not a big problem if slips as late as 25th of month
4.	Management Report B	4.	Nice to have but not essential
5.	Queries via on-line access	5.	Nice to have but on-line not essential

EXHIBIT 2-2

EPA – Agency Standard Hardware/Software

	TARGET HARDWARE ENVIRONMENT				
TOOLS	IBM 3090	IBM 43XX	DEC/VAX	PRIME	IBM/PC
3rd Generation:					
COBOL	●			●	
FORTRAN	●	●	●	●	●
PL/I	●				
PASCAL				●	●
4th Generation:					
INFO			●	●	●
FOCUS	●	●	●		●
NATURAL	●				
SAS	●		●	●	●
dBASE III Plus					●
Easytrieve Plus	●				
Data Base Management					
ADABAS	●				
Graphics Facilities					
TELL-A-GRAPH/ Cuechart	●			●	
VERSAGRAPH				●	
SASGRAPH	●		●	●	
Spreadsheet					
LOTUS 1-2-3					●
20/20				●	
MEGACALC	●				
SAS/FSP	●				
Geo-graphics					
ARC/INFO (Pilot)			●	●	
UNIRAS (Pilot)	●				

EXHIBIT 2-2 (Continued)

EPA – Agency Standard Hardware/Software

TOOLS	TARGET HARDWARE ENVIRONMENT				
	IBM 3090	IBM 43XX	DEC/VAX	PRIME	IBM/PC
Word and Text Software					
LEXITRON WP DEVICE					
LEXITYPE					●
WORDSTAR					●
MULTI-MATE					●
WORD PERFECT					●
WORDMARC				●	
Displaywrite 4					●
BASIS	●				
TEXT WP				●	
INFO-TEXT				●	
Project Management					
Tell-A-Plan	●				
Microsoft Project					●
Telecom Capabilities					
SNA	●	●	●	●	●
ASYNCH ASCII	●		●	●	●
HASP	●	●	●	●	
X25	●		●	●	
PRIMENET				●	
DECNET			●		●
CROSSTALK					●
KERMIT	●		●	●	●
GNET II				●	
PRIMELINK				●	●
NATURAL/CONNECTION	●				●
SAS/Rlink Rterm	●		●		
3270 PC File Transfer	●	●			●
Electronic Mail					
DIALCOM SERVICE					
Local Capability			●	●	
Programmmer Productivity Aids/Facilities					
ISPF	●	●			
LIBRARIAN	●				
EMACS				●	
COBOL DEBUGGER	●				
Fortran/ DEBUGGER	●		●		
EVE/TPU			●		

In reviewing the available hardware/software, the system developer should consider such factors as the following:

- What specific hardware is available or can be made available in physical proximity to the user(s)? What is its accessibility?

- What similar software or data bases already exist, either within EPA or elsewhere, which perform similar functions or contain similar data? For example, EPA's personnel and payroll systems already contain much personnel data, and the Agency's Financial Management System (FMS) contains comprehensive (and accessible) financial files.

- Is the application/system concept one for which software has already been developed and is available either within EPA or through service bureaus? For example, LEXIS/NEXIS, a commercially available software package, provides a means for storage and retrieval of abstracted data bases.

- Has EPA already developed "Core System" applications which can be readily modified? (Consult OIRM/SIRMOs for currently available Core Systems and Standards.)

- How complex are the basic functions which must or could be performed by the automated system, and what software exists to perform these functions (e.g., numerous project management software packages exist which include critical path analysis, as do statistical packages to perform regression analysis etc.)?

- What is the desirable form of the output (hard copy tables, text, graphs and charts, screen display, color graphics etc.), and what hardware/software is available or can be procured to produce this output?

- How long will the hardware/software be available within EPA and when will it be replaced?

- What security arrangements are available for given hardware or software, and are they adequate for the application?

The review of available hardware/software needs to include examination of all of these areas.

Beyond the availability of specific hardware and software applications, option designers should examine the potential hardware and software based upon defined size and flexibility requirements identified in the management and functional requirements and operational specifications analyses.

Exhibits 2-3, 2-4 and 2-5, following this page, present guidelines for the type of software required for an application of a given size and complexity.

Based upon the above reviews, the option designer should have a relatively good feel for the potentially feasible hardware and software options available to meet some or all of the management, functional and operational specifications.

2.2.3 Developing Options by Structuring and Adjusting the Operational Specifications and Varying Manual/Automated Functions

In this step the analyses conducted to date are used to construct manual/automated system options.

In constructing system options, a number of factors must be considered simultaneously. Some of these factors include the following:

- Specific functions which are candidates for automation. All automated systems have a manual component, and the only question is what portion of the process or function will be automated and what will be left as manual processing. Often the feasible alternatives differ in the proportions of the processes and functions that are to be automated.

- The amount of effort (and hence cost) of automating certain functions. For example, full text automation involving voluminous files is usually not a desirable option because of the almost prohibitive effort and cost associated with inputting large amounts of data or text.

- User sophistication and discipline. Automated systems, but particularly sophisticated systems, require considerable effort and discipline to maintain accurate data. If these are not present in the user organization, then a manual or simple system is more highly preferred to a more sophisticated design, and thus the options analysis should include at least one "unsophisticated" option.

- Timing of the management requirement. If a system must be in place quickly, a manual or less sophisticated design will probably be required.

- Availability of the appropriate hardware/software at the time of implementation. Procurement of new hardware or software may take prohibitively long, and/or existing hardware or software may be replaced while the system is being designed.

EXHIBIT 2-3

SOFTWARE SUPPORT TOOL SELECTION MATRIX

SMALL SYSTEMS

SMALL SYSTEMS – # RECORDS < 10K OR TOTAL SIZE < 10 MEGABYTES							
Number of Simultaneous Users		1		1 < n < 15		> 15	
Complex Random Retrievals?		YES	NO	YES	NO	YES	NO
Location of Related Data	None	2,3,6,7	2,3,4,6,7	2,3,6	2,3,4,6	2	2,3,4
	Main-Frame	2,3	2,3,4	2,3	2,3,4	2	2,3,4
	Mini-Computer	6	6	5,6	5,6	2	2,3,4
	PC	7,8,9	7,8,9	2,3,6	2,3,4,6	2	2,3,4

NOTES:

1 –	Mainframe	3GL/DBMS	(COBOL, PL/1, FORTRAN)
2 –	Mainframe	4GL/DBMS	(Natural/ADABAS)
3 –	Mainframe	4GL	(FOCUS)
4 –	Mainframe	4GL	(Natural/VSAM)
5 –	Minicomputer	3GL	(COBOL, FORTRAN, Pascal)
6 –	Minicomputer	4GL	(FOCUS, INFO)
7 –	Microcomputer	4GL	(INFO, FOCUS, dBASE III)
8 –	Microcomputer	4GL/DBMS	(dBASE III)
9 –	Microcomputer	3GL	(FORTRAN, Pascal)

EXHIBIT 2-4

SOFTWARE SUPPORT TOOL SELECTION MATRIX

MEDIUM SYSTEMS

MEDIUM SYSTEMS - 10K < # RECORDS < 100K OR 10 MEGABYTES < TOTAL SIZE < 100 MEGABYTES													
Volatility		Moderate Amount of Change per Day				Volatile				Highly Volatile			
Number of Simultaneous Users		≤ 15		> 15		≤ 15		> 15		≤ 15		> 15	
Complex Random Retrievals?		YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Location of Related Data	None	2,3,6	2,3, 4,6	2	2,4	2,6	2,3, 4,6	2,3	2,4	1,2, 5,6	1,2, 5,6	1,2, 5,6	1,2
	Mini-Computer	6	6	2	2,4	5,6	5,6	2,3	2,4	5,6	5,6	1,2	1,2
	Main-Frame	2,3	2,3,4	2	2,4	2	2,3,4	2,3	2,4	1,2	1,2	1,2	1,2

NOTES: -

1 -	Mainframe	3GL/DBMS	(COBOL, PL/1, FORTRAN)
2 -	Mainframe	4GL/DBMS	(Natural/ADABAS)
3 -	Mainframe	4GL	(FOCUS)
4 -	Mainframe	4GL	(Natural/VSAM)
5 -	Minicomputer	3GL	(COBOL, FORTRAN, Pascal)
6 -	Minicomputer	4GL	(FOCUS, INFO)

EXHIBIT 2-5

SOFTWARE SUPPORT TOOL SELECTION MATRIX

LARGE SYSTEMS

LARGE SYSTEMS – # RECORDS > 100K OR TOTAL SIZE > 100 MEGABYTES									
Volatility		Almost Static (Update Weekly or Less)				Moderate Amount of Change or Volatile		Highly Volatile	
Number of Simultaneous Users		≤ 15		> 15		≤ 15	> 15	≤ 15	> 15
Complex Random Retrievals?		YES	NO	YES	NO	YES	NO	YES	NO
File Pass Frequency	n = 1 per day	2,3	2,3,4	2	2,4	2	2,4	1,2	1,2
	1 < n < 40 per day	2	2,4	2	2,4	2	2,4	1,2	1,2
	n > 40 per day	Hybrid 1,2	4	Hybrid 1,2	4	Hybrid 1,2	4	Hybrid 1,2	Hybrid 1,2

NOTES:

1 –	Mainframe	3GL/DBMS	(COBOL, PL/I, FORTRAN)
2 –	Mainframe	4GL/DBMS	(Natural/ADABAS)
3 –	Mainframe	4GL	(FOCUS)
4 –	Mainframe	4GL	(Natural/VSAM)

Based upon these and other considerations, a set of system options for performing the defined functions should be structured. In general, these options should range from manual processes or procedures, through the most highly automated alternative which is potentially feasible.

In displaying the options, it is highly desirable -- in fact virtually mandatory -- that all the manual and automated functions associated with the option be defined and displayed. In fact these manual/automated differences along with the hardware/software differences are the primary factors which differentiate the options and which will form the basis for the benefit-cost analysis and subsequent option selection.

A recommended analytical technique for defining and specifying the manual/automated alternatives and differences by alternative, is to rely upon the flow charts and the Initial System Concept developed during the Mission Needs Analysis. Beginning with these flow charts (see Exhibits 2-1 and 2-2 of Volume A), updated system concepts can be constructed for each alternative identifying:

- The specific manual functions which must be performed
- The specific system functions which must be performed
- Changes from the current mode of operation.

This clear specification of which functions are to be performed manually and which are to be automated is critical to the development of benefit and cost estimates for each option.

As a final step of this analysis, the defined options should be reviewed with the users to determine their acceptability. This review should include a discussion of the advantages/disadvantages as well as the operational implications (additional staff, new procedures, information security factors, etc.) of each option. The result of this last review with the users is a potential set of options which appear to satisfy to an acceptable degree the management requirements and mission need.

3. OPTIONS ANALYSIS

Selecting an appropriate solution to satisfy the mission need and operational specifications involves evaluating identified options against the identified requirements to determine which alternative most cost-effectively satisfies the requirements. Thus, two analyses must be conducted:

- Operational and technical feasibility analysis
- Life cycle benefit-cost analysis.

Guidance for performing these analyses is provided below.

3.1 OPERATIONAL AND TECHNICAL FEASIBILITY ANALYSIS

For an option to be viable it should be technically, operationally, and economically feasible. The purpose of the operational and technical feasibility analysis is not only to evaluate how well each option meets the requirements identified to date but also to determine how operationally and technically feasible each option is. The primary result of this task is a ranking of the various options in accordance with their capacity to meet the requirements.

Exhibit 3-1, following this page, presents an example of the parameters and a matrix format for conducting an operational and technical feasibility analysis.

Completion of a matrix such as the one shown in Exhibit 3-1 should indicate the extent to which each option is operationally and technically feasible. The matrix can be used, if desired, as a means of ranking options by desirability. This can be done either informally through a joint review of the information by management, users and the system developers, or formally through the development of specific weights to be applied to each criteria and the "scoring" of each option. The total score then becomes the relative desirability of the option.

The results of this analysis will indicate the relative desirability and effectiveness of each option. Before a final determination of an option can be made, however, a life cycle benefit-cost analysis must be conducted.

3.2 LIFE CYCLE BENEFIT-COST ANALYSIS

To ensure that the most cost-effective option is selected, the benefits and costs of each option over the anticipated life of the system must be carefully reviewed. The benefit-cost analysis

EXHIBIT 3-1

OPERATIONAL AND TECHNICAL FEASIBILITY ANALYSIS

OPERATIONAL/TECHNICAL AREA	DEGREE EACH OPTION MEETS REQUIREMENT		
	OPTION I	OPTION II	OPTION III
1. CAPABILITY OF PRODUCING KEY PRODUCTS (MEET MANAGEMENT REQUIREMENT) • "A" • "B" • "C"			
2. DEVELOPMENTAL TIME COMPARED TO NEED			
3. FLEXIBILITY/EXPANDABILITY			
4. ACCEPTABILITY TO MANAGEMENT AND USERS			
5. EXTENSIVENESS OF MANAGEMENT/ OPERATIONAL CHANGES REQUIRED (IF ANY)			
6. RESOURCE AVAILABILITY (STAFF AND DOLLARS)			
7. MANAGEMENT COMMITMENT			
8. RISKS OF DEVELOPMENT/ IMPLEMENTATION (Security, etc.) • Management Risks • System Hardware/Software Risks • Security Risks			
9. AVAILABILITY/ACCESSIBILITY OF HARDWARE AND SOFTWARE			
10. AUTOMATED SYSTEM CHARACTERISTICS • Capability to Interface with Other Systems • User-friendly Interface • Failure and Backup Provisions • Hardware/Software Obsolescence • Site/Physical Plant Requirements			
SCORE			

is a methodology for conducting this analysis. The objective of the analysis is to identify and compare the benefits and costs of feasible options to provide a sound basis for selecting the preferred alternative.

The benefit-cost methodology consists of three tasks:

- Determining and valuing benefits
- Determining and valuing costs
- Comparing total benefits and costs.

The result of the benefit-cost-analysis is the determination of the most cost-effective option. Detailed guidelines for completing the benefit-cost analysis are presented below.

3.2.1 Determining and Valuing Benefits

The purpose of this task is to identify and value the potential benefits of each system option. Benefits usually are expressed in terms of the mission, goals or operating program accomplishments over the expected system operational life-span. These benefits must be identified for each year of system operation. In general, benefits are those accruing when compared to the current situation including a projection of the "base" situation to the future.

Generally, there are three types of potential benefits from automated systems:

- Cost reduction benefits which are a direct result of an automated process being more efficient than a manual process. In general these benefits accrue only when a system is an operational system producing a product, such as payment checks, mailing lists, etc. The methodology for valuing these benefits is a relatively straightforward efficiency analysis.

- Additional capability benefits such as conducting statistical (regression) analyses which cannot be done manually because of the immense number of calculations required. It is often difficult to quantify these benefits.

- Management effectiveness benefits which result from improved management due to improved information from management information systems. In general, it is impossible to directly measure these benefits quantitatively since they stem from the presumed actions of managers who will make better and more informed decisions. The approximate magnitude of these benefits may, however, be inferred by estimating the total cost of the organization being managed and presuming a small increase (2%-10%) in organizational effectiveness or efficiency. For example, if a 1,000 person organization is expending $50 million/year, then a 2% increase in management effectiveness translates into an inferred benefit of $1 million (.02 x $50 million).

Every reasonable effort should be made to identify and quantify benefits in units and dollars with supporting rationale. When benefits cannot be quantified in dollars, they should be expressed in measurable units. Non-quantifiable benefits may be identified if pertinent to the decision. The discussion below presents categories of benefits which may result from a system project.

3.2.1.1 Non-recurring Cost-Reduction Benefits

These are one-time benefits that have a dollar value. The benefits may occur at any point in the life cycle, but they are not continuing benefits.

1) Cost reduction - The value of eliminating owned equipment, excess equipment and inventory, or any other one-time source of quantifiable benefit.

2) Value enhancement - The value of additional tangible procurements (depreciable, not consumable) and improvements to owned facilities and equipment.

3.2.1.2 Recurring Cost-Reduction Benefits

This includes benefits accrued throughout, or during most of, the system life cycle. These cost-reduction benefits should be quantifiable and may include such categories as:

1) Maintenance and Lease of ADP Equipment - The savings for ongoing lease and/or maintenance contracts for ADP equipment.

2) Communications - The savings on rental, lease or maintenance of data communication equipment, services, and facilities.

3) Software Maintenance - The projected savings on the maintenance of application software.

4) Personnel - The salaries and fringe benefits saved (net savings) for operations, data entry, and other personnel.

5) Training and Travel - Savings due to reduced training and travel.

6) Space Occupancy - Savings on equipment space, personnel and support facilities, and administrative offices.

7) Supplies and utilities - Reduction of both technical and administrative supplies.

8) Security - Savings on security guards, devices, etc.

3.2.1.3 Qualitative Benefits

Many important benefits can result from a system without being able to easily quantify them. Examples include:

- Faster processing and/or lower error rate
- Enhanced organizational image
- Improved morale
- Standardization

It may not be possible to precisely quantify these benefits in dollar terms, but they nevertheless should be examined and retained as part of the analysis.

3.2.1.4 Determining Total Benefits

Total benefits are determined by summing annual tangible benefits over the life of the system and adding non-recurring benefits. To determine present value benefits, adjust the benefits over the system life cycle to their present value. The net present value is calculated by subtracting the adjusted cost from the total present value of benefits. FIPS PUB 64 and OMB Circular A-94 provide guidance for calculating the present value of benefits.

3.2.2 Determining and Valuing Costs

The purpose of this task is to determine for each system option all costs and required resources, e.g., personnel, equipment, etc. Costs must be analyzed for each alternative over its life cycle.

The system life cycle includes both the research and developmental, and operational and maintenance phases of the system's life. For example, the costs for conducting the system development process discussed in Volume C must be included in the system life cycle costs. The end of the system life cycle is the projected final year in the useful life of the system, or the last year in which either costs or benefits are incurred.

Only relevant costs must be addressed in the economic analysis. A cost is relevant if the implementation of an alternative would cause currently occurring costs to change. For example, site costs are relevant if the current facilities must be modified or expanded to accommodate the system. Costs which are not impacted by any alternative are the same for all alternatives and, therefore, they are irrelevant to the economic analysis.

Sunk costs are not relevant to the economic analysis. Sunk costs are costs which have already been incurred or are irrevocable due to a prior commitment. Sunk costs are irrelevant to the economic analysis because they will be incurred at the same level regardless of the outcome of the analysis.

Relevant non-informational system costs must be included in the analysis. For example, if workload increases would require future increases to non-information system staff to perform a program mission, goal or operating function, the additional costs must be shown as increased costs of the present system.

Cost estimates must be supported by a reasonably accurate projection of workload and capacity requirements. Specific workload data and associated capacity requirements for each year in the system life must be provided.

The effects of inflation, or anticipated changes in the general price level, are not required in the analysis of costs. If inflation is used in the analysis, the resulting costs must be presented in both present (constant) and future (discounted) dollars.

Although inflation, or an unanticipated increase in the general price level, is not required for the analysis, a known or expected price increase in a specific cost item should be included when the magnitude of the price change may affect the decision (for example: an increase in personnel costs projected due to a planned general Federal pay raise). Note that costs for all years of the system life must be presented in both present and future dollars.

Developmental (non-recurring) and operational (recurring) costs must be separately identified. Developmental costs are one-time costs to acquire hardware, software, telecommunications, facilities, capitalized equipment, training and travel. Operational costs may be incurred over the life of the system and include maintenance, facilities, non-capitalized equipment, supplies, training and travel. Specific types of costs which should be considered in the analysis are identified below.

3.2.2.1 Non-recurring Costs

Non-recurring costs are costs associated with the acquisition of equipment, real property, non-recurring services, non-recurring operations and maintenance (start-up) costs, and other one-time costs. Non-recurring costs need not all occur in a single year. They include costs for:

1) Site Modifications - The cost of erecting or modifying a site and surrounding facilities to meet the needs of the proposed system, e.g., costs to enlarge a computer room and additional space required for personnel involved in this process, etc.

2) ADP Equipment - The cost for hardware, e.g., CPUs, disk drives, security devices, etc.

3) Data Communications - The cost for data communications hardware, communication lines and dedicated data communications software.

4) Software purchase - The cost for system software packages procured for the direct support of the proposed system.

5) Database development - The cost of implementing database system software and database applications software.

6) Software development - The cost of implementing application programs.

7) Studies - The cost of studies associated with the requirements, design development, or implementation of the proposed system.

8) Data Conversion - The cost of converting present data and program logic.

9) Procurement - The cost of procuring hardware, software and data communications such as RFP preparation, vendor evaluation, and contract preparation.

10) Training - The cost of training, including user, operations, and management training.

11) System Test - The cost of evaluating the system, including tests of information security safeguards.

12) Management Overhead - The cost of management interface in the development process defined in terms of hours required for meetings, reviews and administrative

functions associated with continued system operation, etc.

3.2.2.2 Recurring Costs

Recurring (operations) costs are costs of operating the system on an annual basis that continue throughout the system life. They include costs for:

1) Personnel - The salaries and fringe benefits for operations, data entry, and other personnel assigned to the system. Part-time activities should be prorated accordingly.

2) Maintenance and Lease of ADP Equipment - The cost for lease and/or maintenance contracts for ADP equipment.

3) Space Occupancy - The cost of equipment space, personnel and administrative offices.

4) Supplies and Utilities - The cost of both technical and administrative supplies.

5) Timesharing - The cost of buying computer time from a commercial source.

6) Communications - The cost for the rental, lease or maintenance of data communications equipment, services and facilities.

7) Software Maintenance - The cost of maintaining application software.

8) Training - The cost of training and travel for new employees and upgrades.

9) Security - The cost of security guards, security devices, etc.

3.2.2.3 Qualitative Costs

Costs may or may not be measured in quantitative terms. Although the primary emphasis of the benefit-cost analysis is to evaluate measurable impacts, the overall objective is to clarify all of the important effects of any decision. Since this is the case, the identification and consideration of qualitative or intangible effects which usually defy accurate calculation nevertheless play a part in the analysis. Some qualitative costs include, but are not limited to:

- Operational disruptions
- Reduced employee morale
- Degraded organizational image

3.2.2.4 Determining Total Costs

To calculate total costs, the total non-recurring and recurring cost subtotals for each year of the system life are added together. The total annual cost can be converted to present value cost for each year of the system life. The present value will give a more equitable base when alternatives have a wide dispersion in the funding years. A percentage rate must be applied to each year's cost to calculate the present value and aggregate the total system cost. FIPS PUB 64 and OMB Circular A-94 (revised March 27, 1982) provide more detailed guidance for calculating present value costs. The total cost over the system life is derived by summing the total costs for all years of the system life.

3.2.3 Benefit-Cost Comparison

The final step of the benefit-cost analysis is the summation of all benefits and costs, selection of the benefit-cost measure, and arrangement of the benefit-cost display.

The summation of benefits and costs is a straightforward addition which permits total benefits to be compared to costs. If all benefits and costs are measured in dollar terms, then one number will be obtained for each. However, qualitative benefits or costs frequently will be included and in these cases no single number can be obtained and a number of measures may have to be included in the final summation. However, just because a cost or benefit cannot be measured in dollar terms does not mean it can be dropped from the final summation or downrated. If it is a major effect, it must be considered.

The actual quantitative benefit-cost comparison involves three primary calculations:

1) Determination of the benefit-cost ratio
2) Determination of payback period
3) Determination of rate-of-return on investment

Exhibit 3-2 provides a sample format for summarizing both benefits and costs of an option (e.g., Option "A") over the system life cycle period. Exhibit 3-3 provides a sample format for displaying quantitative benefits for all options evaluated in order to allow easier comparison.

EXHIBIT 3-2

SAMPLE SUMMARY OF TIME-PHASED COSTS AND BENEFITS FOR OPTION A

OPTION A								
CATEGORY	**FISCAL YEAR**							
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
SYSTEM DESIGN & DEVELOPMENT COSTS *ACQUIRE/MAINTAIN HARDWARE* *ACQUIRE/MAINTAIN SOFTWARE* *IMPACT COSTS* *TRAINING* *DATA ENTRY* TOTAL COSTS								
CUMULATIVE COSTS								

TOTAL BENEFITS								
CUMULATIVE BENEFITS								

NET BENEFITS								
CUMULATIVE BENEFITS								

EXHIBIT 3-3

SAMPLE SUMMARY OF OPTION BENEFITS AND COSTS

CATEGORY	OPTION A		OPTION B		OPTION C	
	ONE-TIME	ANNUAL	ONE-TIME	ANNUAL	ONE-TIME	ANNUAL
SYSTEM DESIGN & DEVELOPMENT *ACQUIRE/MAINTAIN HARDWARE* *ACQUIRE/MAINTAIN SOFTWARE* *IMPACT COSTS* *TRAINING* *DATA ENTRY*						
TOTAL COSTS						
TIME SAVINGS TO USERS						
NET BENEFITS (BENEFITS - COSTS)						
PAYBACK (ONE-TIME COSTS/NETBENEFITS)						

3.2.3.1 Benefit-Cost Ratio

There are several benefit-cost measures which can be used for comparison purposes. The benefit-cost ratio (B/C) is one measure which gives an approximate multiple of return on the investment costs of a project. Obviously, for a project to be economically viable, benefits should outweigh costs so that the B/C ratio should be greater than 1. Another measure is the ratio of net benefits (benefits minus costs) to costs. This gives an approximate rate of return on investment. A third measure, net benefits (B-C) may be used if the size of benefits is important.

3.2.3.2 Payback Period

The payback period is calculated by determining the year and month in which the sum (in current dollars) of benefits first exceeds the sum of the costs.

3.2.4 OMB Benefit-Cost Approval Criteria

Benefit-cost submissions to OMB for external review and approval must show at least a 10% return on investment or provide substantial additional justification for funding based on satisfying non-financial criteria. OMB has also indicated that particular attention will be paid to narrative amplification of system benefits and costs, including assumptions made, options considered, and the use of sensitivity analysis as a hedge against uncertainty.

4.0 OPTION SELECTION AND DOCUMENTATION

When the procedural steps outlined above have been performed, the options analysis and the life cycle benefit-cost analysis are complete. The results of these analyses provide decision makers with a range of valued alternatives. However, the results must be carefully examined to ensure the accuracy of the analysis, and other factors that may be relevant to option selection must be considered.

4.1 OPTION SELECTION CRITERIA

The results of the operational and technical feasibility analysis and the benefit-cost analysis support decision makers by providing them with required information to make an informed selection. These analyses do not make automatic the decision of which option to select. The selection process, while guided by these analyses, still involves a moderate amount of subjectivity.

One factor which may play an important role in any decision is risk. With any project there is a certain element of risk involved, risk that costs may exceed expectations, that benefits will not materialize as expected, etc. A benefit-cost analysis and the operational and technical feasibility analysis helps minimize risk since they require explicit definition of expected benefits, costs and risks. However, some risk always remains. If there is a high possibility that benefits may not materialize from a project, the project's benefits should be much greater than its costs if a decision to continue is to be made. Similarly, if costs and benefits are almost assuredly known, the project may be viable even at a lower benefit-cost ratio or lower rate-of-return. The risk factor should be evaluated in any decision concerning a project.

Another element of the option selection process which must be taken into account, especially for larger systems, is OMB's requirements governing major system development. As previously noted, OMB requires a 10% return on investment or substantial additional justification if it is to approve such development efforts. In addition, OMB requires (OMB Circular A-11) that budget estimates must be prepared for all "major information system initiatives" which are defined as:

- System design or development costs exceeding $1 million
- System operation and maintenance costs exceeding $500,000/year.

This approval requirement can affect the timing of a system development project and potentially even help decide which option is selected.

Of particular importance in the final decision is the value judgment placed upon qualitative considerations, either those identified in the analysis or others. Frequently, the desirability of the project will hinge on these factors. It is the job of the decision maker to evaluate intangibles in light of his/her knowledge of the project, the people affected by it, and the conditions surrounding it. A final decision must be based upon these factors as well as the results of the benefit-cost analysis.

4.2 DOCUMENTATION REQUIREMENTS

Completion of the analyses described in this volume should be documented in a report outlining the analyses conducted and the results obtained. Appendix A, EEI-2, presents a suggested outline for this report. The report -- EEI-2, Preliminary Design and Options Analysis -- or an equivalent report, must be completed for all system development efforts as described in Chapter 1, section 1.5. If the selected option is a manual solution, it is not strictly necessary to complete the report shown, since justification for a manual system is not required. Nevertheless, it is recommended that basic elements of the documentation be retained for future reference.

It should be remembered that the benefits-cost analysis is an evolving document and that benefits/costs will change as the project progresses and becomes better defined. Therefore, for those system efforts which proceed to the design, development and implementation phase the benefit-cost analysis will require updating.

Additionally, at the conclusion of this phase, if the system development effort appears to be viable and proceeding to design, development and implementation there are certain management actions which must be taken, including:

- Appointment of a project manager and team
- Consideration of establishment of configuration management and quality assurance/control mechanisms
- Development of a Project Management Plan (EEI-3).

The Project Management Plan is an extremely important document and will set out how the system development effort will be accomplished, especially focusing on resources and scheduling as well as other factors. Appendix A, EEI-3, provides a representative outline for a Project Management Plan.

5. SUMMARY

5.1 PRELIMINARY DESIGN AND OPTIONS ANALYSIS OUTPUTS

The outputs, documents and results of the Preliminary Design and Options Analysis are:

- EEI-2, Preliminary Design and Options Analysis
- EEI-3, Updated Project Management Plan
- Detailed supporting documentation and work papers
- Summaries of available options, benefits and costs
- Operational and technical feasibility analysis
- Functional requirements analysis worksheets

5.2 NEXT STEPS

If the option analysis and subsequent Project Management Plan indicate that an automated system should be developed, either wholly or in part, then the next steps would be System Design, System Development, and System Implementation as outlined in Volume C. Otherwise, the program manager should develop the written guidelines and procedures that outline the recommended approach for conducting the process using non-automated methods.

APPENDIX A
ESSENTIAL ELEMENTS OF INFORMATION

APPENDIX A

ESSENTIAL ELEMENTS OF INFORMATION

A. ESSENTIAL ELEMENTS OF INFORMATION

This appendix provides a representative outline of documents that will be developed during the Preliminary Design and Options Analysis phase.

A.1 INTRODUCTION

The documentation requirements contained in this appendix apply to all software development projects, regardless of size, complexity or origin. At a minimum, these standards apply to all new software development projects. Maintenance and/or enhancements to existing information systems must comply with the requirements set out in Chapter 1, section 1.5 of Volume B, Preliminary Design and Options Analysis.

Compliance with the standards and conventions provided in this appendix will ensure that adequate documentation is produced for all system development projects.

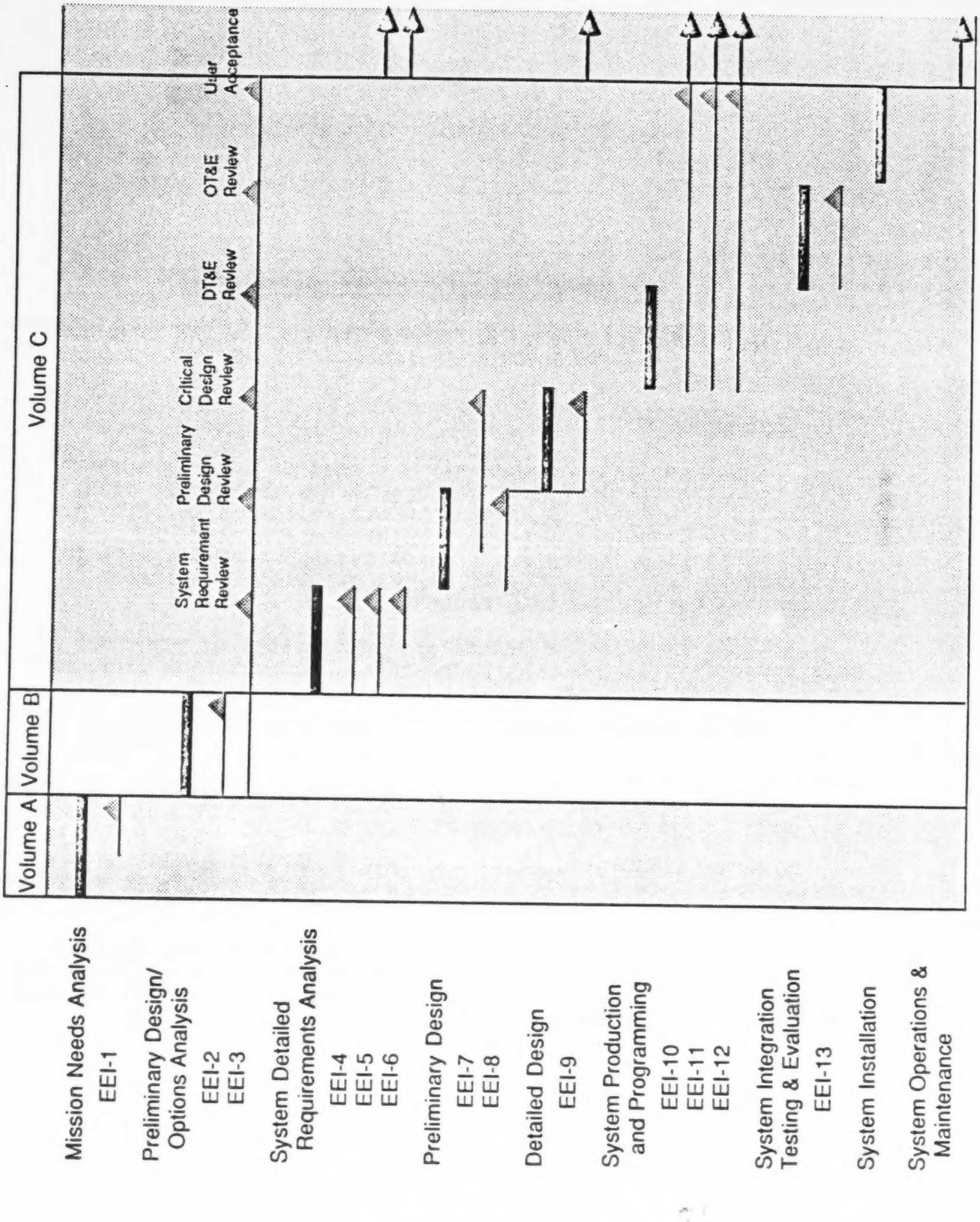
The documents defined in this appendix are:

EEI-2 • • Preliminary Design And Options Analysis
EEI-3 • • Project Management Plan

When an asterisk appears within a section number in the outlines, it represents a repetition of the element as many times as necessary to define multiple iterations of the element.

The following milestone chart illustrates the relative initiation and completion of each document with respect to the software development life cycle, its major phases, and the span and scope of Volumes A, B, and C.

DOCUMENTATION VERSUS LIFE CYCLE



EEI-2 PRELIMINARY DESIGN AND OPTIONS ANALYSIS

EXECUTIVE SUMMARY

- Background
- System Concept
- Option Summary
- Results of Options Analysis

1. INTRODUCTION

    1.1 Background
    1.2 Current System Description
    1.3 Results of Mission Needs Analysis
    1.4 Scope and Purpose

2. OPTION DESIGNS

    2.1 System Concept, Management Requirements and Functional Requirements Summary
    2.2 Operational Requirements Summary (General system requirements like security, etc.)
    2.3 Option Descriptions
        2.3.1 Option 1
        2.3.2 Option 2
        2.3.* Option 3 etc.

3. OPTIONS ANALYSIS

    3.1 Summary of Option Life Cycle Benefits
    3.2 Summary of Option Life Cycle Costs
    3.3 Life Cycle Benefit-Cost Analysis
    3.4 Summary of Risks and Contingencies by Option

4. OPTION RECOMMENDATION (WITH RATIONALE)

EEI-3 PROJECT MANAGEMENT PLAN

EXECUTIVE SUMMARY

- Background
- System Description
- Funding/scheduling
- Accomplishment Plan (including Procurement)
- Risk

1. INTRODUCTION

   1.1 Background
   1.2 Current System Overview

2. System Description

3. Project Team and Support

   3.1 Roles and Responsibilities
   3.2 Configuration Management
   3.3 Quality Assurance/Control
   3.4 Procurement Plan

4. Project Schedule and Task Description

5. Project Budget and Funding

6. Facilities

7. Test Plan Requirements/Constraints

8. Risk Summary/Project Constraints

   8.1 Policy Events
   8.2 Forms and Clearances

EPA

United States
Environmental Protection
Agency

Office of Information
Resources Management
Washington DC 20460

OIRM 87-02C
10/87

EPA SYSTEM DESIGN & DEVELOPMENT GUIDANCE:

VOLUME C: SYSTEM DESIGN, DEVELOPMENT AND IMPLEMENTATION

Volume C
Executive Summary

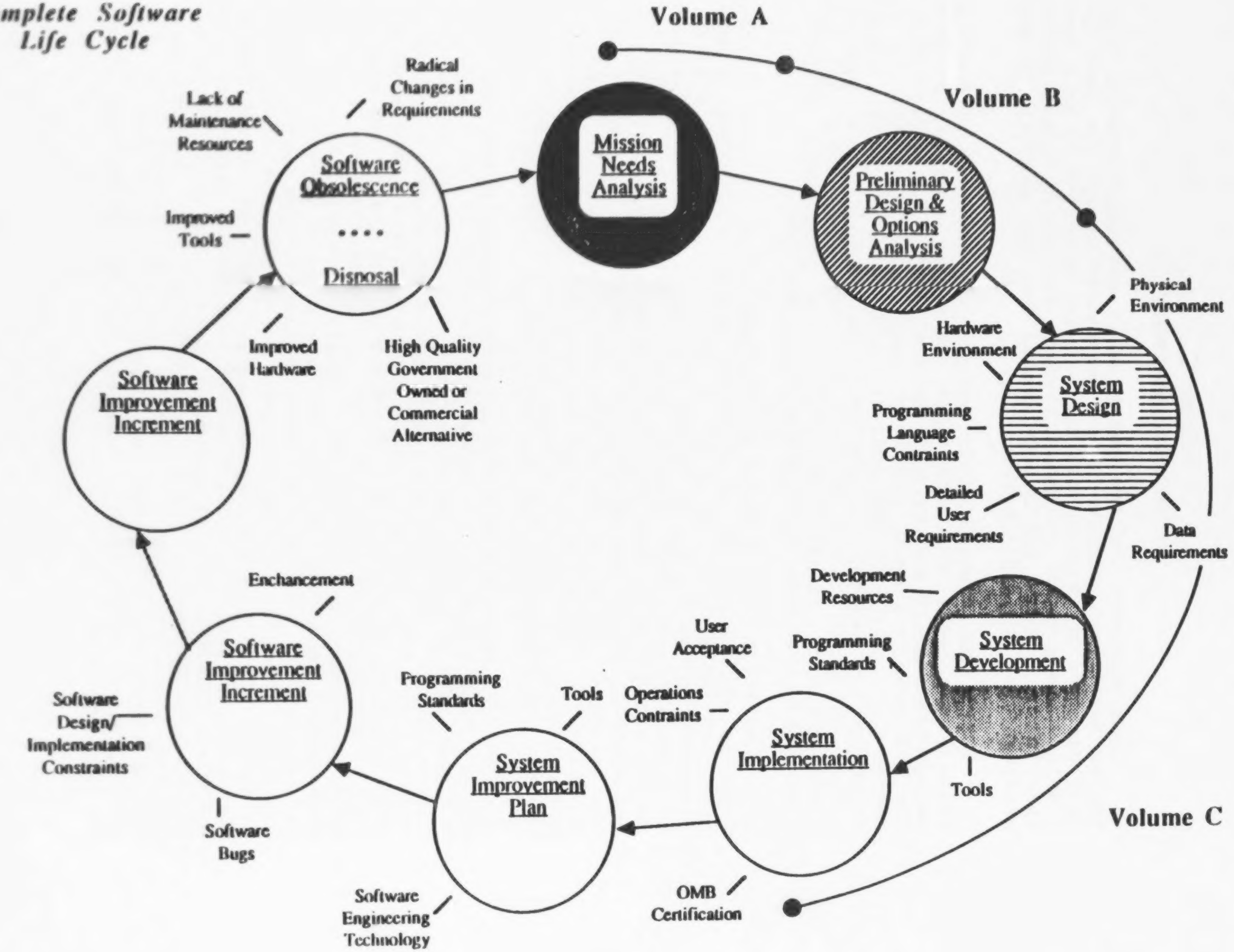
This document defines the process and documentation that system developers prepare during the System Design and Development phase of the system life cycle. The objective of this document is to provide guidance towards satisfying requirements specified in EPA's IRM Policy Manual for the acquisition and management of information technology.

The guidance within this document is intended to provide system developers with specifics concerning software program management, design and related documentation. The objective of the Software Management Plan, outlined in this document, is to ensure the quality of EPA software design, development, implementation and maintenance efforts. The EPA Software Management Program is based on six software engineering elements that include policies, standard software tools, procedures/ methods, guidelines, planning, and oversight and compliance.

Completion of the steps and documentation outlined in this document will result in an automated system that solves a specific problem as outlined in EEI-1, the Mission Needs Statement. Accompanying the automated system will be a sufficient quantity of documentation that detail inputs, outputs and processes within the system. The rationale behind all the documentation requirements is to assure program managers and OIRM staff that the delivered system fulfills its user's requirements, utilizes EPA accepted standards and procedures, and is within the guidance, limitations and constraints imposed on the Agency by OMB, GSA and the Congress of the United States.

The following exhibit describes the complete software life cycle. Each phase in the software life cycle is represented by a bubble with its corresponding title on the inside of the circle. Factors that influence each phase are shown surrounding each circle. The scope of this document covers three separate phases, System Design, System Development and System Implementation. As indicated, factors that influence the System Design phase are programming language constraints, detailed user requirements, data requirements, and the physical environment and the preceding bubble, the Preliminary Design and Options Analysis. The next phase discussed in this volume, System Development, is influenced by the output from the System Design phase and the external influences of development resources, programming standards and development tools. The final phase detailed in this document is System Implementation. As indicated, factors that influence this phase are the outputs from the System Development Process, and external factors such as OMB certification, operations constraints and user acceptance of the delivered product.

Complete Software Life Cycle


Volume A
Volume B
Volume C
Mission Needs Analysis
Preliminary Design & Options Analysis
System Design
System Development
System Implementation
System Improvement Plan
Software Improvement Increment
Software Improvement Increment
Software Obsolescence
....
Disposal
Radical Changes in Requirements
Lack of Maintenance Resources
Improved Tools
Improved Hardware
High Quality Government Owned or Commercial Alternative
Physical Environment
Hardware Environment
Programming Language Contraints
Detailed User Requirements
Data Requirements
Development Resources
Programming Standards
Tools
User Acceptance
Operations Contraints
OMB Certification
Programming Standards
Tools
Software Engineering Technology
Enchancement
Software Design/Implementation Constraints
Software Bugs

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1. INTRODUCTION

Pursuant to the Environmental Protection Agency's IRM Policy Manual, this volume is the third of three volumes which provide guidance for Agency system design and development efforts. This volume provides detailed guidance for the final phase of the EPA system development life cycle process -- the Design, Development and Implementation phase.

Volume C is intended for use by system developers, including Agency staff and contractors, who are actually responsible for system development. It therefore provides detailed guidance for conducting automated system development activities to help insure compatibility and uniformity EPA-wide.

1.1 BACKGROUND

The Environmental Protection Agency expends millions of dollars each year on the design, development, implementation and maintenance of major environmental and administrative systems vital to EPA's programs and administrative functioning. Management of these system resources is becoming increasingly complex, since the rapid development of information technology in the 1980's has dramatically increased computer capacity and user accessibility. The result has been two-fold:

- An increasing number of system development efforts by managers and staff at all organizational levels who, because of access to their own equipment, develop their own systems independently of Agency systems staff
- A wide range of hardware/software options for implementation of any specific system concept or design.

Therefore, there has been a proliferation of system development efforts by a broad range of users with varying levels of sophistication in making system development decisions and conducting system development efforts.

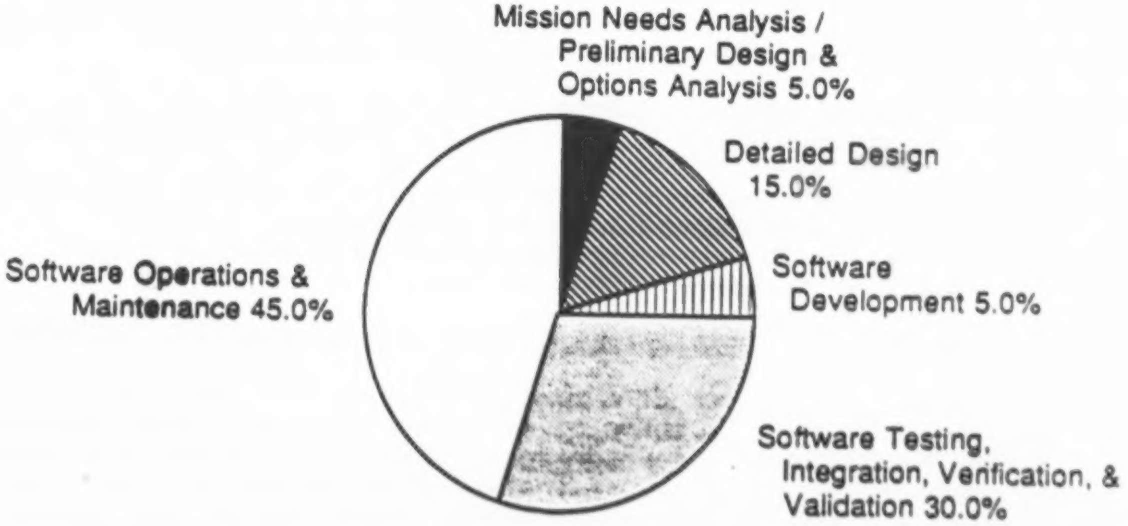
1.2 OBJECTIVES OF THE SYSTEM DESIGN AND DEVELOPMENT GUIDANCE

Within EPA's Office of Administration and Resources Management (OARM), the Office of Information Resources Management (OIRM) is responsible for ensuring the effective and efficient use of EPA's information resources including automated system design, development and maintenance. OIRM's objective in this endeavor is to provide guidance, assistance, and only when necessary, controls, to assure that the Agency's considerable information resources are utilized cost-effectively for the overall benefit of the Agency. To this end, OIRM has developed umbrella policies guiding information system development and acquisition (see Information Resources Management Policy Manual) and has also developed this three-volume set of guidelines and standards to assist with EPA's system development efforts. These three volumes provide sequential guidance for:

- Defining the system requirement (or need) and related operating concept
- Developing feasible system options and selecting the most cost-effective option
- Designing, developing and implementing the selected system option.

Exhibit 1-1, following this page, graphically depicts the three major phases of the system development life cycle and the decisions and results expected of each phase. However, EPA's system development life cycle discussed in these volumes represents little more than fifty-five percent of the total life cycle of a software application. Typical cost allocations for each major component of the total system life cycle are represented in the graph below.

Life Cycle Costs [1]



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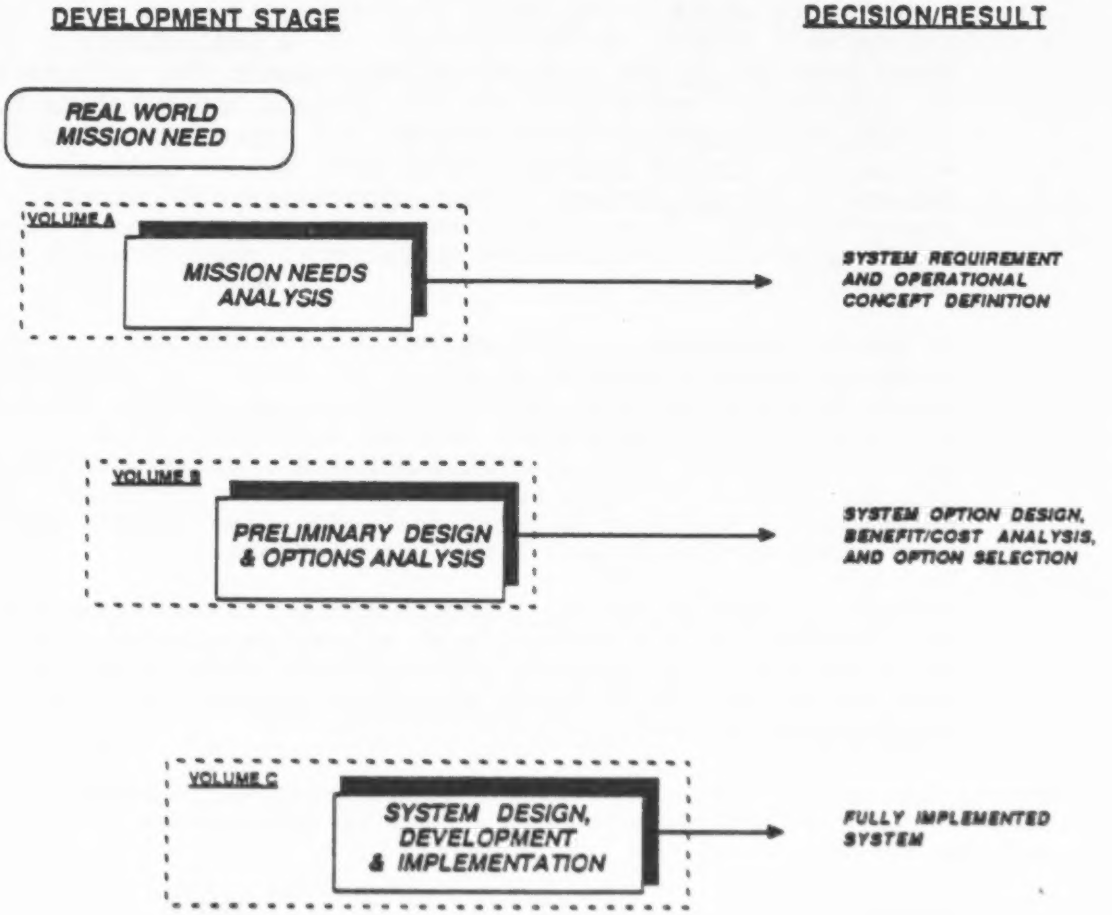
[1] These figures are based on a graphic illustration in Controlling Software Products by Tom DeMarco, 1982, which purports to represent industry averages.

EXHIBIT 1-1

EPA SYSTEM DEVELOPMENT LIFE CYCLE & DECISION PROCESS


DEVELOPMENT STAGE
DECISION/RESULT
REAL WORLD MISSION NEED
VOLUME A
MISSION NEEDS ANALYSIS
SYSTEM REQUIREMENT AND OPERATIONAL CONCEPT DEFINITION
VOLUME B
PRELIMINARY DESIGN & OPTIONS ANALYSIS
SYSTEM OPTION DESIGN, BENEFIT/COST ANALYSIS, AND OPTION SELECTION
VOLUME C
SYSTEM DESIGN, DEVELOPMENT & IMPLEMENTATION
FULLY IMPLEMENTED SYSTEM

This document is the third of the three-volume set. The volumes cover the following:

- Volume A - Mission Needs Analysis -- is designed to provide program managers and staff with a suggested methodology for assessing and evaluating the need (requirement) for an information system. Applying the methodology in this volume will result in two outputs: 1) a preliminary specification of the management requirement for information or information processing and the outputs and benefits tied to the user organization's mission and operations, and 2) an "Initial System Concept" which provides an initial depiction of the system's input, processes and outputs. These results: 1) confirm that a need (requirement) exists and 2) provide a preliminary operational specification of the requirement.

- Volume B - Preliminary Design and Options Analysis -- is directed towards program managers and staff. It provides guidance and a methodology for structuring design options for meeting the requirement defined in Volume A and provides guidance for selecting the most cost-effective option. The steps described in this volume result in the selection of the most mission/cost-effective option (manual or automated) based upon life cycle concepts.

- Volume C - System Design, Development And Implementation -- is intended for use primarily by system developers and provides specific guidance and standards which must be adhered to when undertaking automated system design and development efforts.

Together these three volumes provide comprehensive guidance and standards for the orderly and cost-effective development of automated systems.

It should be noted that the EPA has established a comprehensive information security program through Chapter 8 of the IRM Policy Manual. Because retrofitting security measures into software under development is complex, expensive and risky, security considerations need to be an integral part of the system development life cycle. Consequently, security issues and factors are identified at appropriate points throughout these volumes. A detailed discussion of security design and development considerations is beyond the scope of this guidance. Additional security guidance will be provided in the forthcoming EPA Information Security Manual.

1.3 AUTHORITY

The EPA System Design and Development Guidance derives its authority from Chapter 4 of the IRM Policy Manual, entitled "Software Management," which establishes the Agency Software Management Program. The guidance serves as the primary guidance for Agency system design and development efforts.

1.4 APPLICABILITY OF THE GUIDANCE

Senior Agency managers and responsible staff should read the guidance and become familiar with the standard decision-making process involved with system design and development efforts. They are responsible for ensuring adequate analysis and documentation to support the critical decisions/results illustrated in Exhibit 1-1.

In general, Volumes A and B are intended to assist program offices and/or users in conducting their own initial studies of management requirements, needs, option feasibility and cost-effectiveness. In this context, the term "system" in Volumes A and B refers to a systematic set of processes and/or procedures which can be used to meet the information needs of a user. It does not imply that the "system" will be an automated system.

The full requirements for documentation for automated system development efforts which must be followed to conform to OARM policy are fully discussed in Volume C. Volume C, however, presumes that an automated or partially automated solution has been selected as a result of the Volume B options analysis.

Volume C provides both guidance and standards for automated system development efforts. If the automated system is a relatively small application on a microcomputer targeted for use within a single office (a "user owned information system"), Volume C provides simplified requirements for system design, development and implementation. If the proposed system is a larger application (mainframe or minicomputer), which is mission-critical or involves multiple offices and organizations, Volume C provides both guidance and standards which must be followed by system developers. This will assure uniform, cost-effective system development in accordance with EPA policies, guidelines and standards.

1.5 DOCUMENTATION REQUIREMENTS

In general, the intent of the three-volume System Design and Development Guidance is to provide a consistent focus for system development efforts which will allow both EPA program managers and OARM managers to cost-effectively develop and maintain the Agency's systems. To achieve this goal, certain documentation requirements (termed "Essential Elements of Information" (EEI) documents) must be met. Exhibit 1-2, following this page, summarizes the EEI documentation requirements. As shown, documentation required for the first two phases of the process -- Mission Needs Analysis and the Preliminary Design and Options Analysis -- are limited to one and two documents each, respectively. All system development efforts are subject to the documentation requirements of these first two phases as set out in Volumes A and B.

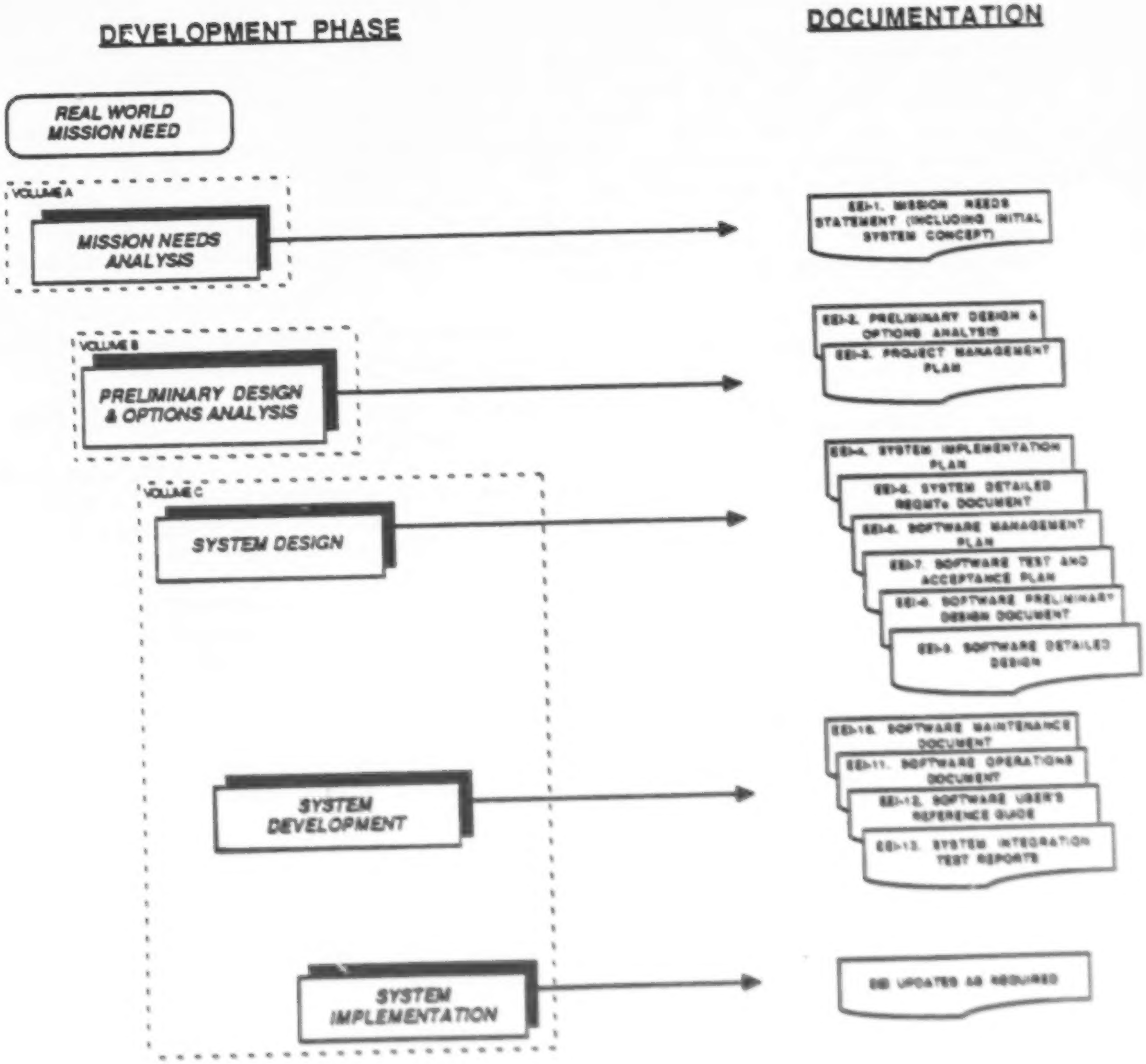
If a full information system development effort is anticipated after these first two phases, then a traditional series of system design and development documents must be developed and submitted as shown in Exhibit 1-2. For certain system development efforts OIRM and office Senior Information Resources Management Officials (SIRMOs) must be involved in a review capacity to fulfill EPA's IRM Policy Manual requirements. Systems falling into one or more of the following categories must have OIRM/SIRMO review involvement:

- EPA mission critical
- States, local governments or other Federal agencies involved
- Interorganizational involvement (e.g., between Assistant Administratorships or including Regional Office involvement)
- Costs for system development/enhancement are projected to exceed $250K (excluding costs associated with long-term system operation and maintenance)
- Information security issues involving the three general security areas: applications security, installation security and personnel security. In total, information security involves the precautions taken to protect the confidentiality, integrity and availability of information
- Privacy Act or confidential business information involved.

For system development efforts falling into any one of these categories, OIRM and office SIRMOs must be involved beginning with a review of EEI-1, generated at the conclusion of the Mission Needs Analysis, as described in Volume A of the EPA System Design and Development Guidance. OIRM/SIRMO review involvement will continue through the development life cycle of these systems and will include all EEI documentation requirements for such systems.

EXHIBIT 1-2

EPA SYSTEM DEVELOPMENT LIFE CYCLE DOCUMENTATION


DEVELOPMENT PHASE
DOCUMENTATION
REAL WORLD MISSION NEED
VOLUME A
MISSION NEEDS ANALYSIS
SEI-1. MISSION NEEDS STATEMENT (INCLUDING INITIAL SYSTEM CONCEPT)
VOLUME B
PRELIMINARY DESIGN & OPTIONS ANALYSIS
SEI-2. PRELIMINARY DESIGN & OPTIONS ANALYSIS
SEI-3. PROJECT MANAGEMENT PLAN
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SYSTEM DESIGN
SEI-4. SYSTEM IMPLEMENTATION PLAN
SEI-5. SYSTEM DETAILED REQMTs DOCUMENT
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SEI-7. SOFTWARE TEST AND ACCEPTANCE PLAN
SEI-8. SOFTWARE PRELIMINARY DESIGN DOCUMENT
SEI-9. SOFTWARE DETAILED DESIGN
SYSTEM DEVELOPMENT
SEI-10. SOFTWARE MAINTENANCE DOCUMENT
SEI-11. SOFTWARE OPERATIONS DOCUMENT
SEI-12. SOFTWARE USER'S REFERENCE GUIDE
SEI-13. SYSTEM INTEGRATION TEST REPORTS
SYSTEM IMPLEMENTATION
SEI UPDATES AS REQUIRED

For systems not falling into one of the above categories, EEIs may be forwarded to OIRM/SIRMOs for information and review as they are developed.

Automated systems involving information security will be subject to one additional documentation requirement -- completion of a certification form (certification of sensitive systems is an OMB requirement). The form, which is under development and will be issued as part of the forthcoming EPA Information Security Manual, will capture basic information on system sensitivity, security requirements, security design, reviews, test scenarios, results and safeguards. Information needed to complete the form will be readily available in the EEI documentation. Prior to the system being placed into use or production, the cognizant SIRMO (or other senior official in the AA/RA's office) will need to certify that the automated system is adequately safeguarded based on the information in the form.

It is not OIRM's intent to burden EPA managers with a host of documentation requirements for each system development effort. The EEIs simply stress typical documentation requirements and their outlines highlight major topics that need to be considered for any system development effort. Managers may use their professional judgment in substituting, combining, or down-scaling the content of the EEIs to meet the unique requirements of their project. Additionally, the EEIs set out in this volume are not meant to conflict with or add more burden to documentation requirements set out in other manuals (e.g., EPA/NCC ADABAS Application Development Procedures Manual). Documentation produced according to such other procedures will invariably satisfy, either partially or fully, some EEI requirements.

Criteria for determining the minimum EEI documentation for a specific system is based on the nature and scope of the information system and its importance to EPA's mission. Four types of systems with differing levels of EEI documentation requirements are identified as follows:

- Major Agency Information System: An information system that requires special continuing management attention because of its importance to an agency mission, its high development, operating, or maintenance costs or its significant impact on administration of Agency programs.

- Widely Accessed Information System: An information system that is not a Major Agency Information System (although it significantly supports accepted program goals and missions) but is widely accessed by a combination of EPA Headquarters, Regional Offices and/or State and local users and other Federal agencies.

- Localized Information System: An information system that is not a Major Agency Information System but significantly supports accepted program goals and missions and is accessed primarily by users in one major area, e.g., EPA Headquarters, a single Agency program, or a Region.
- User Owned Information System: Unique, stand-alone system developed to improve the efficiency or effectiveness of operations for a single user or a small group of users.

Documentation requirements for each of these system categories are projected in Exhibit 1-3 on the next page and in Chapter 4 of Volume C. Policies and procedures covering the submission, review and approval of EEIs by OIRM will be issued under separate guidance.

1.6 ASSISTANCE AND SUPPORT AVAILABLE

Agency Program and Management officials embarking on a system development effort should be aware that there are at least two sources available to them for assistance and support during the system development life cycle:

- Within each AA/RA's office SIRMOs are available for assistance, support and guidance relative to the EPA System Design and Development Guidance and other OIRM guidance and standards (e.g., Core Systems, Structured Programming, etc.)
- OIRM, with its general IRM management oversight role and requirement to exercise procurement approval authority, has a staff organized to support EPA's administrative, program and research communities.

It is appropriate to involve these support sources as early as is feasible in the system development life cycle for most system development efforts.

The primary reasons for early involvement of SIRMOs and OIRM staff are:

- Fulfilling EPA's IRM policy for system development review requirements

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EXHIBIT 1-3

SYSTEM CATEGORY /EEI MATRIX

EEI Requirements / System Category	EEI-1 Mission Needs Analysis	EEI-2 Preliminary Design and Options Analysis	EEI-3 Project Management Plan	EEI-4 System Implementation Plan	EEI-5 System Detailed Requirements Document	EEI-6 Software Management Plan	EEI-7 Software Test and Acceptance Plan	EEI-8 Software Preliminary Design Document	EEI-9 Software Detailed Design Document	EEI-10 Software Maintenance Document	EEI-11 Software Operations Document	EEI-12 Software User's Reference Guide	EEI-13 System Integration Test Report
Systems That Require OIRM Involvement [1]	●	●	●	●	●	●	●	●	●	●	●	●	●
Major Agency Information Systems	●	●	●	●	●	●	●	●	●	●	●	●	●
Widely Accessed Information Systems	●	●	●	●	●	●	●	●	●	●	●	●	●
Localized Information Systems	●	●	●	●	●				●	●	●	●	●
User Owned Information Systems	●				●				●	●	●	●	

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[1] As detailed on page 1-6.

- Providing a value-added service role involving consultation, assistance, technical standards, guidance and interpretation of requirements
- Expediting procurement for system development efforts which proceed to the system design, development and implementation phase
- Providing assistance in determining user needs as early as possible in the life cycle.

Achieving these objectives will strengthen EPA's system development efforts and avoid major pitfalls that have beset system development efforts in other government agencies (e.g., project stalls due to outyear funding shortages stemming from under-projected planning or project disruptions due to failure to get hardware/software acquisitions into the procurement cycle expeditiously and when required).

The remainder of Volume C provides guidance and standards for conducting the third phase of the system development process -- the System Design, Development and Implementation phase.

2. SOFTWARE MANAGEMENT PROGRAM

Implementation of the EPA Software Management Program draws on the experience of software professionals within EPA and on the experience of the Federal Government through both the Office of Information Resources Management, the General Services Administration and the Institute for Computer Sciences and Technology of the National Bureau of Standards.

The objective of the Software Management Program is to ensure the quality with which EPA designs, develops, implements and maintains software. The EPA Software Management Program consists of the following Software Engineering Elements:

- Policies
- Standard Software Tools
- Procedures/Methods
- Guidelines
- Planning, and
- Oversight and Compliance.

This volume specifically addresses standard software tools, procedures/methods, guidelines, planning and oversight and compliance.

2.1 APPLICABILITY TO SMALL AND LARGE PROJECTS

The Software Management Program is designed to be applicable to both large and small projects. Managers of specific projects must use their professional judgment (aided by the guidelines provided in this methodology) on how to apply the Software Management Program. For larger projects, the Software Management Program should be used in its entirety. For smaller software projects, the Software Management Program should be adjusted to meet the needs of the specific project. For example, a judgment might be made that the documentation requirements are excessive for a particular project, so parts of different documents could be combined or eliminated to reduce the number of documents and level of documentation required.

2.2 QUALITY SOFTWARE

The Software Management Program will produce significant results, including:

- Improved inter-organizational relationships
    - Demonstrated software engineering expertise
    - Improved user acceptance of final products
    - Improved ability to react to changes

  - Increased reliability of the software
  - Improved maintainability of the software

- Institutionalization of the software development process
  - Enhanced technology transfer between projects
  - Better utilization of personnel resources
  - Reduced dependency on specific individuals
  - Improved ability to measure and control software development for project scheduling and cost purposes
  - A production line approach to software development and maintenance
- Reduced cost of developing and maintaining software
  - Increased programmer productivity
  - Fewer problems (errors) with delivered products
  - More easily enhanced software
- Improved software portability
  - Isolation of computer architecture dependencies
  - Elimination of non-standard source code
  - Development of reusable source code

The Software Management Program has been developed to assist personnel directly involved in software development projects, including:

- Program Managers -- It provides assurance that EPA will apply uniform, cost-effective methods throughout its software life cycle projects. New projects need not produce their own unique software management and development procedures, but, through the Software Management Program, can benefit from the experience of successful software development projects.
- Project Managers -- It includes the "what, why and how" of software life cycle management.
- Programmers and Analysts -- It describes specific tools and techniques for the software development life cycle.

2.3 SOFTWARE MANAGEMENT PROGRAM OVERVIEW

The EPA Software Management Program includes a system development life cycle model, and for each phase of the life cycle

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process, the software engineering components related to controlling and regulating that phase. The Software Management Program has major inputs from Volumes A and B of the System Design and Development Guidance series. These inputs are:

. Phase 1 - Mission Needs Analysis

Mission Needs Statement (including Initial System Concept) is produced during the Mission Needs Analysis phase.

. Phase 2 - Preliminary Design and Options Analysis

Preliminary Design and Options Analysis Document and a Project Management Plan are produced during the Preliminary Design and Options Analysis phase.

The Software Management Program defines the following additional phase of the system development life cycle:

. Phase 3 - System Design, Development and Implementation

Detailed discussions of this phase are contained in Chapter 3 of this document.

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3. SYSTEM DESIGN, DEVELOPMENT, AND IMPLEMENTATION OVERVIEW

This chapter addresses the third phase of the system development life cycle -- the System Design, Development and Implementation phase and provides amplifying details on the three stages which comprise this phase:

- System Design Stage - which comprises tasks and activities associated with System Detailed Requirements Analysis, Preliminary Design and Detailed Design;
- System Development Stage - which comprises tasks and activities associated with System Production and Programming and System Integration, Test and Evaluation; and
- System Implementation Stage - which comprises tasks and activities associated with System Installation, and System Operation, Maintenance and Evaluation.

For each stage it discusses the associated tasks and activities, reviews, baselines and documentation requirements. Exhibit 3-1, on the following page, overviews the process.

There are EEI documentation requirements during the System Design, Development and Implementation phase. While each is generally discussed in this chapter, detailed representative outlines for each EEI (numbers 4-13) are contained in Appendix A. EEIs 1-3 were detailed previously in Volumes A and B.

3.1 SYSTEM DESIGN STAGE

Associated tasks and activities include System Detailed Requirements Analysis, Preliminary Design and Detailed Design.

3.1.1 System Detailed Requirements Analysis

The major inputs to this task are the:

- Mission Needs Statement document produced during the Mission Needs Analysis phase -- defined in Volume A
- Preliminary Design and Options Analysis Document and Project Management Plan produced during the Preliminary Design and Options Analysis phase -- defined in Volume B.

These documents are used in performing the detailed requirements analysis for the software system. The conclusions

EXHIBIT 3-1

System Design, Development and Implementation Life Cycle Phase

Life-Cycle Phase	**System Design, Development and Implementation**						
Stages	**System Design**			**System Development**		**System Implementation**	
Tasks And Activities	**System Detailed Requirements Analysis**	**Preliminary Design**	**Detailed Design**	**System Production And Programming**	**System Integration, Test, And Evaluation**	**System Installation**	**System Operation, Maintenance, And Evaluation**
Documentation Requirements (EE18)	System Implementation Plan (EEI-4) System Detailed Requirements Document (EEI-5) Software Management Plan (EEI-6)	Software Test and Acceptance Plan (EEI-7) Software Preliminary Design Document (EEI-8) ⇨	Software Detailed Design Document (EEI-9)	Software Maintenance Document (EEI-10) Software Operations Document (EEI-11) Software User's Reference Guide (EEI-12)	System Integration Test Reports (EEI-13)		System Detailed Requirements Document (EEI-5) Software Management Plan (EEI-6) Software Detailed Design Document (EEI-9) Software Maintenance Document (EEI-10) Software Operations Document (EEI-11) Software User's Reference Guide (EEI-12) System Integration Test Reports (EEI-13)
Audits				Functional Configuration Review # 1 Physical Configuration Review # 1	Functional Configuration Review #2 Physical Configuration Review # 2		
Reviews	System Requirements Review	Preliminary Design Review	Critical Design Review	Development Test And Evaluation Review	Operational Test And Evaluation Review	User Acceptance	
Baselines	Functional Baseline	Preliminary Design Baseline	Design Baseline	Product Baseline	Operational Baseline		

of these documents are confirmed by the software development staff that will ultimately produce the software system.

This task entails further analysis of the problem, the definition of the functional components of the major software and hardware elements of the system and association of functional components to requirements. The scope of the software development project is revised, if necessary, and further defined.

3.1.1.1 Activities

The activities associated with the System Detailed Requirements Analysis are:

- Confirm the analysis of current systems that have been reviewed and their adequacy/inadequacy for use in solving the problem
- Confirm the alternative solutions that have been proposed and ensure that the selected alternative is the one that should be used
- Prepare the System Implementation Plan
    - Identify events, actions and milestones
    - Identify resource requirements
    - Review schedules and work plans
    - Produce integrated project plan
- Prepare the System Detailed Requirements Document
    - Define major system functions
    - Define physical requirements
    - Define security requirements
    - Define quality requirements
    - Define life cycle resource requirements
    - Define testing and verification requirements
    - Define project work schedule(s) and work plan(s)
- Prepare the Software Management Plan
    - Identify project resources
    - Define review responsibilities
    - Identify organizational structure and required resources
    - Establish project schedules, reviews and reporting controls
    - Implement risk management
    - Implement software product assurance procedures
    - Implement software development procedures for the project

While defining the System Detailed Requirements, a separate data dictionary document should be prepared that lists and describes each data element to be referenced by the system. [Guidance on the content and format of the Data Dictionary Document will be provided at a future date by OIRM.]

3.1.1.2 Documentation

Documentation associated with the System Detailed Requirements Analysis includes:

. System Implementation Plan	EEI-4	(Final)
. System Detailed Requirements Document	EEI-5	(Preliminary)
. Software Management Plan	EEI-6	(Preliminary)

3.1.1.3 System Requirements Review

The System Requirements Review is performed to ensure the adequacy of the system requirements and approve formally the definition of the user's requirements. The System Detailed Requirements Document is the primary subject of the review. The Software Management Plan and the System Implementation Plan are also input to the review process.

The System Requirements Review takes place at the end of the System Detailed Requirements Analysis task. A successful System Requirements Review results in the establishment of the Functional Baseline. OIRM/SIRMO representation should be ensured at the System Requirements Review.

3.1.1.4 Functional Baseline

The Functional Baseline is established as the original baseline configuration and consists of the functional system specifications contained in the System Detailed Requirements Document (EEI-5). Once the System Detailed Requirements Document is baselined, any changes to that document represent a change in the scope of the project and must have management approval. The Functional Baseline is established after a successful System Requirements Review.

3.1.2 Preliminary Design

The Preliminary Design task represents the initial effort in producing a design that can be used in producing an operational software product.

3.1.2.1 Activities

The activities associated with Preliminary Design are:

- Confirm that candidate packages/existing software can be used or integrated into the new system
- Prepare Software Design Document
    - Identify each software design requirement
    - Identify the functional flow of the system, address each design requirement and describe each requirement and associated software design functions (SDFs)
    - Detail each SDF by defining:
        - Inputs
        - Local Data
        - Initiation, Timing and Sequencing
        - Interrupts
        - Processing
        - Outputs
        - Adaptation
    - Define Data Base and File Structures
        - Data Base Management System
        - Logical Design of the Data Structures
        - Data Interrelationships
        - Characteristic/Requirements Traceability
- Update Software Management Plan
- Prepare preliminary Software Test and Acceptance Plan
    - Software Unit Test Plans
        - Test Requirements
        - Test Management
        - Test Schedule
        - Tests and Results
    - Integration Testing of Software Units, Modules and Software Functions - Test Plans
        - Integration Test Requirements
        - Integration Test Management
        - Integration Test Categories
        - Integration Test Methods
        - Integration Test Schedules
        - Integration Tests and Results
    - Required Resources for Unit and Integration Testing

    - Facilities
    - Hardware Environment
    - Interface/Support Software
    - Personnel

- System Test Plans
    - System Test Requirements
    - System Test Management
    - System Test Categories
    - System Test Methods
    - System Test Schedules
    - System Tests and Results

- User Acceptance Test Plans
    - Test Team
    - Pretest Procedures
    - Acceptance Test Procedures
    - Formal Acceptance

- Address:
    - Initial design of user procedures
    - Conversion software and appropriate procedures
    - Operations procedures.

3.1.2.2 Documentation

Documentation associated with the Preliminary Design task includes:

. Software Management Plan	EEI-6 (Updated)
. Software Test and Acceptance Plan	EEI-7 (Preliminary)
. Software Preliminary Design Document	EEI-8 (Final)

3.1.2.3 Preliminary Design Review

The Preliminary Design Review is performed for each system element to ensure the adequacy of the preliminary design and the test plans for verifying the accuracy of the software system. The Software Preliminary Design Document and the Software Test and Acceptance Plan are the primary subject of the review. The updated Software Management Plan is also input to the review process.

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The purpose of the Preliminary Design Review is to:

- Evaluate the progress, technical adequacy and risk resolution (on a technical, cost and schedule basis) of the selected design approach
- Determine the compatibility of the selected design approach with the requirements and performance of the System Detailed Requirements Document
- Establish the existence and compatibility of the physical and functional interfaces among the other elements (equipment, facilities, computer programs and personnel)
- Determine the adequacy of the test plans in accurately verifying the software system against the design criteria.

The Preliminary Design Review takes place at the end of the Preliminary Design task. A successful Preliminary Design Review results in the establishment of the Preliminary Design Baseline. OIRM/SIRMO representation should be ensured at the Preliminary Design Review.

3.1.2.4 Preliminary Design Baseline

The Preliminary Design Baseline is established after a successful Preliminary Design Review. It consists of the initial design specifications -- including data base specifications. The Preliminary Design Baseline is made up of the Software Preliminary Design Document (EEI-8) and the Software Test and Acceptance Plan (EEI-7). Once these documents are baselined, any changes to those documents represent a change in the scope of the project and must have management approval.

3.1.3 Detailed Design

The Detailed Design task represents the final effort in producing a detailed design that will be used in producing an operational software product. The Software Detailed Design Document is prepared using the information in the Software Preliminary Design Document prepared during Preliminary Design. It is refined, and additional detail is added to produce a detailed design adequate for code production. The first draft of the Software User's Reference Guide may be prepared. The Software Management Plan and Software Test and Acceptance Plan are updated as necessary. The Project Management Plan and Benefit-Cost Analysis should be updated during this task.

3.1.3.1 Activities

The activities associated with Detailed Design include:

- Prepare Software Detailed Design Document
  - Update/refine preliminary design information
  - Decompose each Software Design Function
    - -- Software Unit Formal Parameters
    - -- Software Unit Inputs
    - -- Software Unit Local Data
    - -- Software Unit Processing
    - -- Software Unit Outputs
    - -- Software Unit Limitations
    - -- Use of other software elements
  - Data Base Physical Design
    - -- File
    - -- Record
    - -- Field
    - -- Item
- Prepare initial draft of EEI-12, Software User's Reference Guide with at least sections one through three completed and a detailed outline of the remainder of the document
  - Description of the system
  - System access techniques
  - User analysis/reporting options
  - Data entry and update process
  - User support and training program/sources
  - Security requirements
- Update Software Management Plan
- Update Software Test and Acceptance Plan.

3.1.3.2 Documentation

Documentation associated with the Detailed Design includes:

. Preliminary Design and Options Analysis	EEI-2	(Updated)
. Project Management Plan	EEI-3	(Updated)
. Software Management Plan	EEI-6	(Updated)
. Software Test and Acceptance Plan	EEI-7	(Final)
. Software Detailed Design Document	EEI-9	(Final)

- Software User's Reference Guide EEI-12 (Preliminary)

3.1.3.3 Critical Design Review

The Critical Design Review is conducted for each system element when the detailed design is complete. The Software Detailed Design Document and the updated Software Test and Acceptance Plan are the primary subject of the review. The Software Management Plan and the Software User's Reference Guide are also input to the review as necessary. The purpose is to accomplish the following:

- Determine that the detailed design of the software system element under review satisfies the performance requirements of the System Detailed Requirements Document
- Establish compatibility among system elements in the detailed design
- Assess the producibility and risk areas (on a technical, cost and schedule basis).
- Review the preliminary product specifications.

A successful Critical Design Review establishes or updates the Design Baseline. The Design Baseline is then used as the basis for the production and coding of the software system. OIRM/ SIRMO representation should be ensured at the Critical Design Review.

3.1.3.4 Design Baseline

The Design Baseline is established after a successful Critical Design Review. It consists of the final design specifications -- including data base specifications and the test plans associated with the software product. The Detailed Design Baseline is made up of the Software Detailed Design Document (EEI-9) and the final Software Test and Acceptance Plan (EEI-7). Once these documents are baselined, any changes to the documents represent a change in the scope of the project and must have management approval.

3.2 SYSTEM DEVELOPMENT STAGE

Associated tasks include System Production and Programming, and System Integration, Test and Evaluation.

3.2.1 System Production and Programming

The specifications developed during the System Design stage are used to develop a system that functions correctly in a controlled environment. At the completion of the System Production and Programming task, all programs, job streams, data bases, security controls, user procedures and operations procedures will have been developed and thoroughly tested by the development team.

3.2.1.1 Activities

The activities associated with System Production and Programming are:

- Develop Software System
  - Code software units
  - Review software unit code
  - Unit test software unit code
  - Produce unit test reports
  - Perform subsystem integration testing
  - Prepare subsystem integration test reports
- Prepare Software Maintenance Document
  - Maintenance Procedures including:
    - Source Code Standards
    - Documentation Update Procedures
    - Coding and Review Process
    - Change Control Process
    - Testing Standards and Procedures
    - Change Implementation Methods
  - Maintenance Tools
    - Technical tools
    - Management tools
  - Source code
    - Source listings or equivalent
- Prepare Software Operations Document
  - System Initialization
  - System Restart by Functional Element
  - System Manager functions
  - System Backup/Recovery Provisions and other Information Security Provisions.

3.2.1.2 Documentation

Documentation associated with the System Production and Programming task includes:

. Software Maintenance Document	EEI-10	(Preliminary)
. Software Operations Document	EEI-11	(Preliminary)
. Software User's Reference Guide	EEI-12	(Updated)
. Unit Tested Source Code		
. Unit Test Data.		

3.2.1.3 System Production and Programming Reviews

Preliminary Functional Configuration and Physical Configuration reviews are performed as each piece of software is delivered for inclusion into the product baseline. They confirm that the software product or component of the software product performs according to the requirements and design specifications that have been prepared and baselined during System Design.

The results of the review are input to the Development Test and Evaluation Review.

3.2.1.4 Development Test and Evaluation Review

The Development Test and Evaluation Review ensures that the developmental testing of the software is successful and that the system requirements are satisfied. The Software Maintenance Document, the Software Operations Document, the updated User's Guide, the results of the Functional Configuration Review and the results of the Physical Configuration Review are also reviewed for completeness and accuracy. Upon completion of a successful review, these documents are placed in the Product Baseline.

The Development Test and Evaluation Review is performed at the end of the System Production and Programming task. A successful Development Test and Evaluation Review establishes or updates the Product Baseline. OIRM/SIRMO representation should be ensured at the Development Test and Evaluation Review.

3.2.1.5 Product Baseline

The Product Baseline establishes a tested, operable version of the software system in its operating environment. As each subsystem is successfully tested, the product baseline is updated. The baseline of the completed and tested version of the software product ensures that any changes or enhancements take place against a stable, controlled set of functional and technical components. The Product Baseline will include the completed product specifications, the operation/maintenance documents and the user's guide.

The Product Baseline is established/updated after a successful Development Test and Evaluation Review at the end of the System Production and Programming task.

3.2.2 System Integration, Test and Evaluation

The System Integration, Test and Evaluation task includes the testing of the fully integrated software product in its operational environment. This task is performed by a test team that does not include any of the software development team members. The purpose is to provide a test and evaluation environment that is independent of the development effort.

The Software Maintenance Document, the Software Operations Document and the Software User's Reference Guide are updated as necessary based on the testing process. The software product and its related documents may have to be sent back to the development team if rework is required based on the results of system integration testing.

3.2.2.1 Activities

The activities associated with the System Integration, Test and Evaluation task are:

- Install the working system using the installation procedures
- Execute the System Test portion of the Software Test and Acceptance Plan
- Document any discrepancies noted during testing for resolution with the development team and user
- Verify that discrepancies that require software modification have been modified correctly
- Prepare System Integration Test Report
- Recommend disposition of the software and documentation.

3.2.2.2 Documentation

Documentation associated with the System Integration, Test and Evaluation task includes:

. Software Maintenance Document	EEI-10	(Updated)
. Software Operations Document	EEI-11	(Updated)

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- Software User's Reference Guide EEI-12 (Updated)
- System Integration Test Reports EEI-13 (Final)
- System Integration Tested Software
- System Integration Test Data

3.2.2.3 System Integration, Test and Evaluation Reviews

The final Functional Configuration and the Physical Configuration reviews are performed when all the subsystems are delivered and integrated into the Product Baseline. They confirm that the software product or component of the software product performs according to the requirements and design specifications baselined in the Product Baseline.

The results of the review are input to the Operational Test and Evaluation Review.

3.2.2.4 Operational Test and Evaluation Review

The Operational Test and Evaluation Review ensures that the software system is viable in its intended environment. The Operational Test and Evaluation Review is performed at the end of the System Integration, Test and Evaluation task.

The Software Maintenance Document, Software Operations Document and the User's Guide are the major inputs to the review. The System Integration Test Reports drive the review in that they contain the results of testing the software product. All errors or incidents that were encountered during formal testing are identified. The resolution of each incident is noted. Those incidents that were determined to be errors are presented in two categories -- corrected and unresolved. This information is used in determining if the software product is ready for formal use. A successful Operational Test and Evaluation Review establishes or updates the Operational Baseline. OIRM/SIRMO representation should be ensured at the Operational Test and Evaluation Review.

3.2.2.5 Operational Baseline

The Operational Baseline represents the completely implemented and tested software system. It is the basis for future maintenance changes and enhancements. All documentation is modified as required, validation and acceptance testing is completed and the system is placed in production and/or turned over to the user. The Operational Baseline is established and/or updated after a successful Operational Test and Evaluation Review.

3.3 SYSTEM IMPLEMENTATION STAGE

This stage comprises System Installation and System Operation, Maintenance and Evaluation.

3.3.1 System Installation

The System Installation task is primarily for formal user acceptance of the software product. The software product is installed in a production environment, and the user exercises the product to determine if it meets his/her needs and requirements.

3.3.1.1 Activities

The activities associated with System Installation are:

- Installation of the software product in a production environment

- User acceptance of the software product

- User training.

3.3.1.2 Major Products

The major products associated with System Installation are:

- Operational software installed
- Training completed
- User agreement to accept the software and documentation.

In addition, the final version of the following system documentation is delivered:

. System Detailed Requirements Document	EEI-5
. **Software** Management Plan	EEI-6
. **Software** Detailed Design Document	EEI-9
. **Software** Maintenance Document	EEI-10
. **Software** Operations Document	EEI-11
. **Software** User's Reference Guide	EEI-12
. System Integration Test Reports	EEI-13

3.3.2 System Operation, Maintenance and Evaluation

The System Operation, Maintenance and Evaluation task begins after the user has formally accepted the software system and its supporting documentation at the end of System Installation. The software product is placed in operation and made available for use. Formal user support and maintenance procedures are established and implemented.

While this is the last task in the system development life cycle, it in itself represents the beginning of the software maintenance life cycle. As the software product matures and changes must be made to it, this process will replicate the previous phases of the EPA system development life cycle -- from the Mission Needs Analysis through System Installation. Exhibit 3-2 presents the software maintenance life cycle concept.

3.3.2.1 Activities

The activities for this task include:

- Operate the system to the degree necessary
- Provide user support for questions, training, etc.
- Log and categorize software problems as they are identified
- Log software enhancement requests
- Perform periodic reviews of the software product and its related documentation to ensure that the product is meeting user/Agency needs
- Determine when identified problems/enhancement requests justify a new release/version of the system product.

When the nature of the problems/enhancement requests justify a new release or new version of the software product, the changes/modifications will be subject to the system development life cycle. While the effort and duration of the 'maintenance' life cycle process might not be as rigorous and lengthy as the initial development effort -- all of the steps and procedures must be followed to ensure that:

- The EPA mission is properly supported
- The quality of the maintained software product and its related documentation is not compromised.

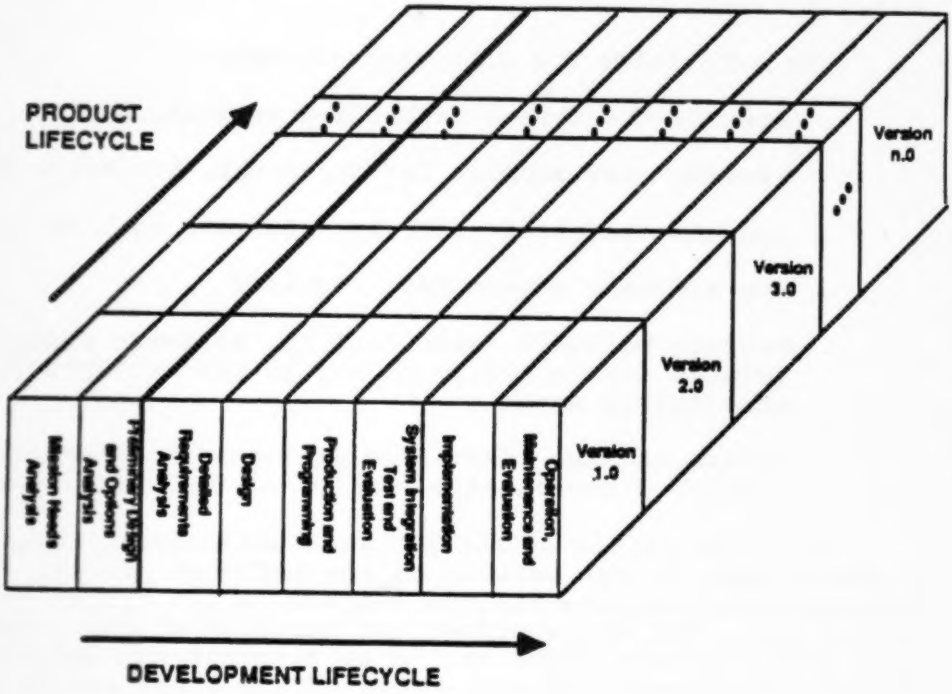
The nature, complexity and cost of the modifications will dictate the degree to which the 'maintenance' life cycle is followed. Simple 'bug' fixes may not require the scrutiny and analysis that a major enhancement must undergo.

3.3.2.2 Documentation

Documentation maintained or updated during the System Operation, Maintenance and Evaluation task includes the

EXHIBIT 3-2

SOFTWARE MAINTENANCE LIFE CYCLE


PRODUCT LIFECYCLE
Mission Needs Analysis
Preliminary Design and Options Analysis
Detailed Requirements Analysis
Design
Production and Programming
System Integration Test and Evaluation
Implementation
Operation, Maintenance and Evaluation
Version 1.0
Version 2.0
Version 3.0
Version n.0
DEVELOPMENT LIFECYCLE

documentation that is delivered with the operational system including versions of the:

. System Detailed Requirements Document	EEI-5
. Software Management Plan	EEI-6
. Software Detailed Design Document	EEI-9
. Software Maintenance Document	EEI-10
. Software Operations Document	EEI-11
. Software User's Reference Guide	EEI-12
. System Integration Test Reports	EEI-13

4. SOFTWARE ENGINEERING COMPONENTS

This chapter addresses the software engineering components necessary to successfully implement the EPA Software Management Program during the EPA software development life cycle phases and the quality assurance considerations for successful software development.

4.1 SOFTWARE ENGINEERING COMPONENTS

There are four software engineering components that direct, control or support each of the life cycle phases and are essential to the successful execution of each phase. These software engineering components are:

- Standards
- Procedures/methodologies
- Software Development Support Tools
- Quality Assurance.

Each life cycle phase is supported, in different degrees, by the four software engineering components. These components provide the necessary technology and discipline to create a software engineering environment.

4.1.1 Standards

Standards are grouped in two major categories: methodology standards (uniform procedures for accomplishing a function) and performance standards (metrics to evaluate performance).

Methodology standards allow work to be accomplished systematically. They facilitate the turnover of work whether it is from personnel working in one life cycle phase to those working in another life cycle phase or among personnel working on the project. Personnel trained in the Software Engineering Program should be able to join a project at any time and become productive soon thereafter.

Performance standards deal with the quantifiable aspect of a task, for example, the amount of time it should take to perform a task and the expected quality of the task's end product. Performance standards depend on methodology standards being in place and enforced so that performance can be measured accurately.

4.1.2 Procedures/Methodologies

Procedures/methodologies define the processes that are followed in each of the particular phases of the system development life cycle.

The two classes of procedures are manual and automated. Manual procedures, which programmers and analysts follow when performing a task, direct the flow of activities. For example, a programming procedures manual provides the direction for achieving progress using the proper programming language elements, associated structured techniques and source code formatting. Automated procedures, on the other hand, direct the execution of computer programs and software development support tools.

4.1.3 Software Development Support Tools

Software Development Support Tools are computer programs used to automate some of the labor intensive activities involved in the management, design, coding, testing, validation and maintenance of application programs. Software development support tools are used in support of standards and procedures/methodologies by EPA and its contractors in the software development and maintenance process.

4.1.4 Quality Assurance

Quality Assurance is the formal process of measuring or evaluating the degree to which a product meets the standards by which it was developed and the specifications upon which it was based. Each product (both software and documentation) produced within each life cycle phase should be subjected to a Quality Assurance process.

4.2 SOFTWARE ENGINEERING PRINCIPLES

Effective system development requires a thorough understanding of the user's requirements coupled with a development process capable of fulfilling those requirements with a responsive system. A clear understanding must be established of the user's requirements, their relationship to the overall system and the functional elements constituting the system. The EPA Software Management Program provides an approach to software development that divides the life cycle into well defined phases.

The Software Management Program indicates the activities and tasks that should be performed for each phase of the life cycle and the resulting deliverables. It also identifies what has to be done, when it should be done and how it should be done.

The Software Engineering Program defines the Essential Elements of Information (EEIs) or documentation that should be produced and/or updated. The baselines for each phase and reviews necessary to approve the documentation are also defined in the Software Engineering Program.

The characteristics of an evolving system are defined and documented in increasing detail at logical transition points, or baselines, of the software development life cycle. Approved documentation and/or software products constitute a baseline. At any time in the system life cycle, all previously established baselines, together with any approved changes to these baselines, constitute the formal identification of the system and its components.

The type of system being developed will dictate the level of documentation necessary to support that system. The diligent use of EEIs will resolve the conflicts that arise between the:

- Cost of documentation
- Classical life cycle for system development
- Changes in computing capabilities and system development techniques.

The use of Fourth Generation Languages (4GL) have, in many instances, provided:

- Significant gains in productivity
- Shortened life cycle development time, and
- Products that better reflect user requirements.

The use of new software production techniques which include the use of 4GLs in software development, while possibly changing the order and timing of the production of system documentation, has not eliminated or reduced the need for adequate system documentation.

The use of the EEIs defined in this volume represent a flexible approach to system documentation. All systems require some form of documentation. However, the degree of documentation needed is dependent on the nature of the system, constituency (who will use it), and life cycle costs. Software systems that are used nationwide, Agencywide and support major program initiatives require complete documentation and thoughtful consideration of options, life cycle costs and mission needs.

Key points to consider are:

- A mission needs analysis and a requirements analysis which includes feasibility and benefit-cost analyses must be conducted prior to embarking on a major agency information system development effort.

- EEIs are required for both new systems and existing systems.
- The EEI outlines contained in Appendix A of this volume represent the basic EEI requirements (see section 4.2.1 for the minimum EEI requirements for the different sizes and types of systems). Information managers may want to increase the depth and breadth of these EEIs based on the circumstances of the project. For example:
  - Elements not included in a particular EEI outline that are considered necessary within a specific project may be added, thus tailoring the EEI for that specific project.
  - Additional EEIs may have to be developed to meet the specific needs of a given software system or project.

4.2.1 Determining Documentation Requirements

Criteria for determining the minimum EEI documentation for a specific software system are based on the nature and scope of the information system and its importance to EPA's mission. Four types of systems are presented below along with guidance for determining the minimum level of EEI documentation for each:

a. Major Agency Information System: An information system that requires special continuing management attention because of its importance to an agency mission, its high development, operating, or maintenance costs or its significant impact on administration of agency programs.

In this context, a system which requires obligations of more than $500,000 per year to maintain or whose software component contains more than 500,000 lines of 3GL source code or 100,000 lines of 4GL source code is considered a Major Agency Information System.

Exhibit 4-1 presents the EEIs required for a Major Agency Information System.

b. Widely Accessed Information System: An information system that is not a Major Agency Information System, (but significantly supports accepted program goals and missions). It is widely accessed by a combination of EPA Headquarters, Regional Offices and/or State and local users and other Federal agencies.

Exhibit 4-1 also presents the EEIs required for a Widely Accessed Information System.

EXHIBIT 4-1

EEI REQUIREMENTS FOR MAJOR AGENCY AND WIDELY ACCESSED INFORMATION SYSTEMS

Life-Cycle Phase	System Design, Development and Implementation						
Stages	**System Design**			**System Development**		**System Implementation**	
Tasks And Activities	**System Detailed Requirements Analysis**	**Preliminary Design**	**Detailed Design**	**System Production And Programming**	**System Integration, Test, And Evaluation**	**System Installation**	**System Operation, Maintenance, And Evaluation**
Documentation Requirements (EEI8)	System Implementation Plan (EEI-4) System Detailed Requirements Document (EEI-5) Software Management Plan (EEI-6)	Software Test and Acceptance Plan (EEI-7) Software Preliminary Design Document (EEI-8)	⇨ Software Detailed Design Document (EEI-9)	Software Maintenance Document (EEI-10) Software Operations Document (EEI-11) Software User's Reference Guide (EEI-12)	System Integration Test Reports (EEI-13)		System Detailed Requirements Document (EEI-5) Software Management Plan (EEI-6) Software Detailed Design Document (EEI-9) Software Maintenance Document (EEI-10) Software Operations Document (EEI-11) Software User's Reference Guide (EEI-12) System Integration Test Reports (EEI-13)
Audits				Functional Configuration Review # 1 Physical Configuration Review # 1	Functional Configuration Review #2 Physical Configuration Review # 2		
Reviews	System Requirements Review	Preliminary Design Review	Critical Design Review	Development Test And Evaluation Review	Operational Test And Evaluation Review	User Acceptance	
Baselines	Functional Baseline	Preliminary Design Baseline	Design Baseline	Product Baseline	Operational Baseline		

c. Localized Information System: An information system that is not a Major Agency Information System, but significantly supports accepted program goals and missions. It is accessed primarily by users in one major area, e.g., EPA Headquarters, a single agency program, or a Region.

Exhibit 4-2 presents the EEIs required for a Localized Information System.

d. User Owned Information System: Unique, stand-alone system developed to improve the efficiency or effectiveness of operations for a single user or a small group of users.

Exhibit 4-3 presents the EEIs required for a User Owned Information System.

4.2.2 Software Life Cycle Reviews

Formal reviews are carried out at key points in the life cycle to ensure that the software development activities are progressing consistent with user requirements and EPA standards. The reviews used in the EPA System Development life cycle are described in detail in Chapter 3.

EXHIBIT 4-2

EEI REQUIREMENTS FOR LOCALIZED INFORMATION SYSTEMS

Life-Cycle Phase	System Design, Development and Implementation						
Stages	System Design			System Development		System Implementation	
Tasks And Activities	System Detailed Requirements Analysis	Preliminary Design	Detailed Design	System Production And Programming	System Integration, Test, And Evaluation	System Installation	System Operation, Maintenance, And Evaluation
Documentation Requirements (EEI8)	System Implementation Plan (EEI-4) System Detailed Requirements Document (EEI-5)		Software Detailed Design Document (EEI-9)	Software Maintenance Document (EEI-10) Software Operations Document (EEI-11) Software User's Reference Guide (EEI-12)	System Integration Test Reports (EEI-13)		System Detailed Requirements Document (EEI-5) Software Detailed Design Document (EEI-9) Software Maintenance Document (EEI-10) Software Operations Document (EEI-11) Software User's Reference Guide (EEI-12) System Integration Test Reports (EEI-13)
Audits				Functional Configuration Review # 1 Physical Configuration Review # 1	Functional Configuration Review #2 Physical Configuration Review # 2		
Reviews	System Requirements Review	Preliminary Design Review	Critical Design Review	Development Test And Evaluation Review	Operational Test And Evaluation Review	User Acceptance	
Baselines	Functional Baseline	Preliminary Design Baseline	Design Baseline	Product Baseline	Operational Baseline		

EXHIBIT 4-3

EEI REQUIREMENTS FOR USER OWNED INFORMATION SYSTEMS

Life-Cycle Phase	System Design, Development and Implementation						
Stages	System Design			System Development		System Implementation	
Tasks And Activities	System Detailed Requirements Analysis	Preliminary Design	Detailed Design	System Production And Programming	System Integration, Test, And Evaluation	System Installation	System Operation, Maintenance, And Evaluation
Documentation Requirements (EEI8)	System Detailed Requirements Document (EEI 5)		Software Detailed Design Document (EEI 9)	Software Maintenance Document (EEI 10) Software Operations Document (EEI 11) Software User's Reference Guide (EEI 12)	N/A		System Detailed Requirements Document (EEI 5) Software Detailed Design Document (EEI 9) Software Maintenance Document (EEI 10) Software Operations Document (EEI 11) Software User's Reference Guide (EEI 12)
Audits				Functional Configuration Review # 1 Physical Configuration Review # 1	Functional Configuration Review #2 Physical Configuration Review # 2		
Reviews	System Requirements Review	Preliminary Design Review	Critical Design Review	Development Test And Evaluation Review	Operational Test And Evaluation Review	User Acceptance	
Baselines	Functional Baseline	Preliminary Design Baseline	Design Baseline	Product Baseline	Operational Baseline		

5. SOFTWARE DEVELOPMENT STANDARDS

This chapter addresses the software development standards that have been approved for use in the development of EPA information systems. They include standard 3rd and 4th generation programming languages, data base management systems, core system standards, specialized software tools, graphics packages and telecommunications support software.

5.1 STANDARD PROGRAMMING LANGUAGES

EPA standard programming languages have been established for use in developing software systems for use within EPA. These include the 3rd generation programming languages that have been standardized by the American National Standards Institute as national standards and by the Institute for Computer Science and Technology of the National Bureau of Standards as Federal Information Processing Standards.

In addition, EPA has internally standardized several 4th generation programming languages in the interest of improving productivity and reducing the cost of software development and maintenance within the agency. Exhibit 5-1 presents the standard programming languages used within EPA.

5.1.1 Programming Language Selection Guidelines

A number of factors go into deciding what computer environment in which an application will operate. After the computer hardware configuration has been identified, the application programming language and associated support software tools must be selected. While there is no "right" answer for each information system being developed, the use of common sense and the guidelines presented in this volume can lead to a reasonable solution.

Software developers should consider the following questions:

- Is an off-the-shelf solution available?
- Has OIRM staff advice been solicited?
- Is the application covered by an existing Core System?
- Can the application be satisfied by using an existing system or its software (e.g., software reuse, off-the-shelf software, consulting the EPA Information System Inventory)?

EXHIBIT 5-1

EPA STANDARD APPLICATION PROGRAMMING LANGUAGES

APPLICATION SOFTWARE PROGRAMMING LANGUAGE		STANDARD	
		EPA	FIPS
3GL	COBOL	Yes	Yes
	FORTRAN	Yes	Yes
	PL/I	Yes	Yes
	PASCAL	Yes	Yes
4GL	INFO	Yes	
	NATURAL	Yes	
	FOCUS	Yes	
	dBASE III	Yes	
	SAS	Yes	

Some of the factors which should be addressed when determining the hardware/software environment are:

- Results of the requirement and feasibility studies
- Potential life span of the application
- Resources available now and in the future to support both the development and maintenance of the application
- Telecommunications and local communications facilities
- Location and size of the data base(s)
- Number of users / Number of simultaneous users
- Complexity of the data
- Information security needs such as access controls, backup, and recovery.

In an attempt to reduce the complexity of this effort, EPA has defined the computer hardware/software environments available for use. As a guideline, a decision matrix approach to identifying what software support tools are appropriate has been defined.

The decision matrices can be used to help determine the support tools appropriate to system development in the absence of OIRM staff guidance. The matrices apply only to the general systems which store and retrieve information and should not be construed as taking precedence over existing EPA system plans, strategies and policies. Also they do not encompass statistical systems, spread sheet systems, graphics systems and other specialized functional systems. With minor exceptions, they do not address hybrid systems - those which are developed using two or more support tools (e.g., Natural/VSAM for data entry and Natural/ADABAS for data retrieval).

The Software Support Tool Selection Matrices address systems that are small, medium, and large.

- Small Systems - are generally programmed using 4GLs with or without data base support, and they can run in either the mainframe, minicomputer or microcomputer environments;
- Medium Systems - are generally programmed using either 3GLs or 4GLs with or without data base support, and they can run in either the mainframe or minicomputer environments and;

- **Large Systems** - are generally programmed using either 3GLs or 4GLs with or without data base support, and they run in the mainframe environment.

The content of each matrix cell and the criteria of small, medium and large systems are simplified to make them useful. There are several decision criteria along the legs of the matrices and numbers in the intersections of the rows and columns which correspond to the software support tools. The key for the software support tools is:

1 - Mainframe	3GL/DBMS	(COBOL, PL/I, FORTRAN)
2 - Mainframe	4GL/DBMS	(Natural/ADABAS)
3 - Mainframe	4GL	(FOCUS)
4 - Mainframe	4GL	(NATURAL/VSAM)
5 - Minicomputer	3GL	(COBOL, FORTRAN, PASCAL)
6 - Minicomputer	4GL	(FOCUS, INFO)
7 - Microcomputer	4GL	(INFO, FOCUS, dBASE III)
8 - Microcomputer	4GL/DBMS	(dBASE III)
9 - Microcomputer	3GL	(FORTRAN, PASCAL)

Exhibits 5-2, 5-3, and 5-4, on the following pages, present the Software Support Tool Selection Matrices.

5.1.2 Source Program Design and Coding Conventions

EPA has a general set of minimum program design and program coding standards which can be obtained from OIRM or office SIRMOs. These standards promote productivity, source code maintainability and software sharing and reuse. These standards are patterned after the standards used by the Department of Defense. The salient characteristics of these standards are:

- Use of structured programming constructs to control the flow of execution
- Elimination or significant reduction in the use of "GO TO" statements and complicated negative Boolean expressions
- Applicability to 3GL and 4GL programming
- Modularity in source program design and coding
- Good documentation practices such as:
  - Naming conventions
  - Symbolic parameters
  - Paragraphing
  - Blocking

EXHIBIT 5-2

SOFTWARE SUPPORT TOOL SELECTION MATRIX

SMALL SYSTEMS

SMALL SYSTEMS – # RECORDS < 10K OR TOTAL SIZE < 10 MEGABYTES							
Number of Simultaneous Users		1		1 < n < 15		> 15	
Complex Random Retrievals?		YES	NO	YES	NO	YES	NO
Location of Related Data	None	2,3,6,7	2,3,4,6,7	2,3,6	2,3,4,6	2	2,3,4
	Main-Frame	2,3	2,3,4	2,3	2,3,4	2	2,3,4
	Mini-Computer	6	6	5,6	5,6	2	2,3,4
	PC	7,8,9	7,8,9	2,3,6	2,3,4,6	2	2,3,4

NOTES:

1 –	Mainframe	3GL/DBMS	(COBOL, PL/1, FORTRAN)
2 –	Mainframe	4GL/DBMS	(Natural/ADABAS)
3 –	Mainframe	4GL	(FOCUS)
4 –	Mainframe	4GL	(Natural/VSAM)
5 –	Minicomputer	3GL	(COBOL, FORTRAN, Pascal)
6 –	Minicomputer	4GL	(FOCUS, INFO)
7 –	Microcomputer	4GL	(INFO, FOCUS, dBASE III)
8 –	Microcomputer	4GL/DBMS	(dBASE III)
9 –	Microcomputer	3GL	(FORTRAN, Pascal)

EXHIBIT 5-3

SOFTWARE SUPPORT TOOL SELECTION MATRIX

MEDIUM SYSTEMS

MEDIUM SYSTEMS – 10K < # RECORDS < 100K OR 10 MEGABYTES < TOTAL SIZE < 100 MEGABYTES													
Volatility		Moderate Amount of Change per Day				Volatile				Highly Volatile			
Number of Simultaneous Users		≤ 15		> 15		≤ 15		> 15		≤ 15		> 15	
Complex Random Retrievals?		YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Location of Related Data	None	2,3,6	2,3,4,6	2	2,4	2,6	2,3,4,6	2,3	2,4	1,2,5,6	1,2,5,6	1,2,5,6	1,2
	Mini-Computer	6	6	2	2,4	5,6	5,6	2,3	2,4	5,6	5,6	1,2	1,2
	Main-Frame	2,3	2,3,4	2	2,4	2	2,3,4	2,3	2,4	1,2	1,2	1,2	1,2

NOTES:

1 – Mainframe 3GL/DBMS (COBOL, PL/1, FORTRAN)
2 – Mainframe 4GL/DBMS (Natural/ADABAS)
3 – Mainframe 4GL (FOCUS)
4 – Mainframe 4GL (Natural/VSAM)

5 – Minicomputer 3GL (COBOL, FORTRAN, Pascal)
6 – Minicomputer 4GL (FOCUS, INFO)

EXHIBIT 5-4

SOFTWARE SUPPORT TOOL SELECTION MATRIX

LARGE SYSTEMS

LARGE SYSTEMS – # RECORDS > 100K OR TOTAL SIZE > 100 MEGABYTES									
Volatility		Almost Static (Update Weekly or Less)				Moderate Amount of Change or Volatile		Highly Volatile	
Number of Simultaneous Users		≤ 15		> 15		≤ 15	> 15	≤ 15	> 15
Complex Random Retrievals?		YES	NO	YES	NO	YES	NO	YES	NO
File Pass Frequency	n = 1 per day	2,3	2,3,4	2	2,4	2	2,4	1,2	1,2
	1 < n < 40 per day	2	2,4	2	2,4	2	2,4	1,2	1,2
	n > 40 per day	Hybrid 1,2	4	Hybrid 1,2	4	Hybrid 1,2	4	Hybrid 1,2	Hybrid 1,2

NOTES:

1 –	Mainframe	3GL/DBMS	(COBOL, PL/I, FORTRAN)
2 –	Mainframe	4GL/DBMS	(Natural/ADABAS)
3 –	Mainframe	4GL	(FOCUS)
4 –	Mainframe	4GL	(Natural/VSAM)

- Indentation of source code
- Single statement per line
- Intelligent use of comments
- Error messages

The program design and source programming standards are maintained and updated by OIRM and are held by office SIRMOs.

5.2 CORE SYSTEM STANDARDS

EPA's Office of Information Resources Management has developed an important set of software engineering standards in response to the growing concern for custom software development on small and/or localized systems (personal computers and minicomputers). In an effort to avoid the costly duplication of application development, OIRM is developing a generic set of core systems which include:

- Project Tracking
- Correspondence Control
- Bibliographic Retrieval
- Mailing List and Label Generation
- Travel Management
- Forms Generation
- Personnel Tracking.

As other core systems are developed, they will be made available through the EPA System Design and Development Guidance.

An outgrowth of this effort was the development of core system standards for the development of core systems for EPA microcomputers (IBM Personal Computers) and minicomputers (Prime 2250, 2550, and 2665 minicomputers). The objectives for a standardized design for core systems are to:

- Provide clarity and consistency between core system applications

- Identify functional commonalities between core system applications

- Reduce the costs of similar one time development efforts through the availability of common software

- Provide the basis for the modular development of a System Builder for core systems.

The standards that have been developed and are included in the Software Engineering Program are:

- End-User Interface
- Software Engineering

- Data Interchange
- User Documentation.

These standards must be followed by developers of small systems -- e.g., those produced for use on minicomputers and microcomputers. The Core System Standards can be obtained from OIRM or office SIRMOs.

5.3 EPA STANDARD SPECIALIZED SOFTWARE TOOLS

The EPA has a number of specialized tools for use on its various computer hardware configurations. The standard specialized software packages that have been approved for use in the development of EPA software systems are presented in Exhibit 5-5. For detailed information on current software development standards contact OIRM or office SIRMOs.

5.4 HARDWARE/SOFTWARE ENVIRONMENTAL STANDARDS

The EPA standard hardware/software environments available for software development are presented in Exhibit 5-6. This exhibit identifies the EPA standard software packages that are available and the hardware environments in which each of the software packages is supported. Any software development effort which uses software packages or hardware outside the EPA Hardware/Software Environment Standards must have approval from the Director, Office of Information Resources Management (OIRM).

EXHIBIT 5-5

EPA STANDARD SPECIALIZED SOFTWARE TOOLS

FUNCTION	TOOL	INTEGRATED WITH
Data Base Management	ADABAS	NATURAL
	dBASE III	
Graphics	SASGRAPH	SAS
	TELAGRAPH	
	VERSAGRAPH	INFO
Geographics	ARC/INFO	INFO
	UNIRAS	
Spreadsheet	LOTUS 1-2-3	
	20/20	
	MEGACALC	
Word Processing	LEXITRON	
	LEXITYPE	
	WORDSTAR	
	MULTI-MATE	
	TEXT	
	WORD MARC	INFO-TEXT
Text Processing and Retrieval	BASIS	
	INFO-TEXT	INFO
	ATMS	
Programmer Tools	ISPF	
	EMACS	
Software Maintenance Tools	LIBRARIAN	
	COBOL DEBUGGERS	
	PL/I DEBUGGERS	
Communications Software	SNA	
	DECNET	
	PRIMENET	
	GNET II	
	PRIMELINK	PRIME/PC Connection
	CROSSTALK	
	KERMIT	

EXHIBIT 5-6

EPA – Agency Standard Hardware/Software

TOOLS	TARGET HARDWARE ENVIRONMENT				
	IBM 3090	IBM 43XX	DEC/VAX	PRIME	IBM/PC
3rd Generation:					
COBOL	●			●	
FORTRAN	●	●	●	●	●
PL/I	●				
PASCAL				●	●
4th Generation:					
INFO			●	●	●
FOCUS	●	●	●		●
NATURAL	●				
SAS	●		●	●	●
dBASE III Plus					●
Easytrieve Plus	●				
Data Base Management					
ADABAS	●				
Graphics Facilities					
TELL-A-GRAPH/ Cuechart	●			●	
VERSAGRAPH				●	
SASGRAPH	●		●	●	
Spreadsheet					
LOTUS 1-2-3					●
20/20				●	
MEGACALC	●				
SAS/FSP	●				
Geo-graphics					
ARC/INFO (Pilot)			●	●	
UNIRAS (Pilot)	●				

EXHIBIT 5-6 (Continued)

EPA – Agency Standard Hardware/Software

	TARGET HARDWARE ENVIRONMENT				
TOOLS	IBM 3090	IBM 43XX	DEC/VAX	PRIME	IBM/PC
Word and Text Software					
LEXITRON WP DEVICE					
LEXITYPE					●
WORDSTAR					●
MULTI-MATE					●
WORD PERFECT					●
WORDMARC				●	
Displaywrite 4					●
BASIS	●				
TEXT WP				●	
INFO-TEXT				●	
Project Management					
Tell-A-Plan	●				
Microsoft Project					●
Telecom Capabilities					
SNA	●	●	●	●	●
ASYNCH ASCII	●		●	●	●
HASP	●	●	●	●	
X25	●		●	●	
PRIMENET				●	
DECNET			●		●
CROSSTALK					●
KERMIT	●		●	●	●
GNET II				●	
PRIMELINK				●	●
NATURAL/CONNECTION	●				●
SAS/Rlink Rterm	●		●		
3270 PC File Transfer	●	●			●
Electronic Mail					
DIALCOM SERVICE					
Local Capability			●	●	
Programmmer Productivity Aids/Facilities					
ISPF	●	●			
LIBRARIAN	●				
EMACS				●	
COBOL DEBUGGER	●				
Fortran DEBUGGER	●		●		
EVE/TPU			●		

6. SUMMARY

6.1 SYSTEM DESIGN, DEVELOPMENT AND IMPLEMENTATION OUTPUTS

The outputs, documents and results of the System Design, Development and Implementation process are as follows:

- EEI-4, System Implementation Plan*
- EEI-5, System Detailed Requirements Document
- EEI-6, Software Management Plan*
- EEI-7, Software Test and Acceptance Plan*
- EEI-8, Software Preliminary Design Document*
- EEI-9, Software Detailed Design Document*
- EEI-10, Software Maintenance Document
- EEI-11, Software Operations Document
- EEI-12, Software User's Reference Guide
- EEI-13, System Integration Test Reports*

- Working, tested and user accepted automated or partially automated solution to the problem

- Established Configuration Management or change control procedures

* Note: These EEI requirements are the basic requirements for User Owned Systems that DO NOT involve OIRM.

6.2 NEXT STEPS

After the user has accepted the application system it begins the transition to the operation and maintenance phase of the system life cycle. The application specific guidelines for conducting this phase are outlined in the Software Maintenance Document, EEI-10, which is required for all systems. The key elements during the maintenance phase of the life cycle are planning, analysis, preparation, improvement and implementation.

[Guidance concerning the Maintenance and Operation phase of the software life cycle will be released under a separate cover.]

APPENDIX A
ESSENTIAL ELEMENTS OF INFORMATION

APPENDIX A

ESSENTIAL ELEMENTS OF INFORMATION

A. ESSENTIAL ELEMENTS OF INFORMATION

This appendix provides representative outlines of each of the system-level documents that will be developed during the system design, development and implementation phase.

A.1 INTRODUCTION

The documentation requirements contained in this appendix apply to all software development projects, regardless of size, complexity or origin -- except as noted in subsection 4.2.1, "Determining Documentation Requirements" in Chapter 4 of this Volume. At a minimum, these standards apply to all new software development projects. Maintenance and/or enhancements to existing information systems must comply with the requirements set out in Chapter 1, section 1.5 of Volume C, System Design, Development and Implementation.

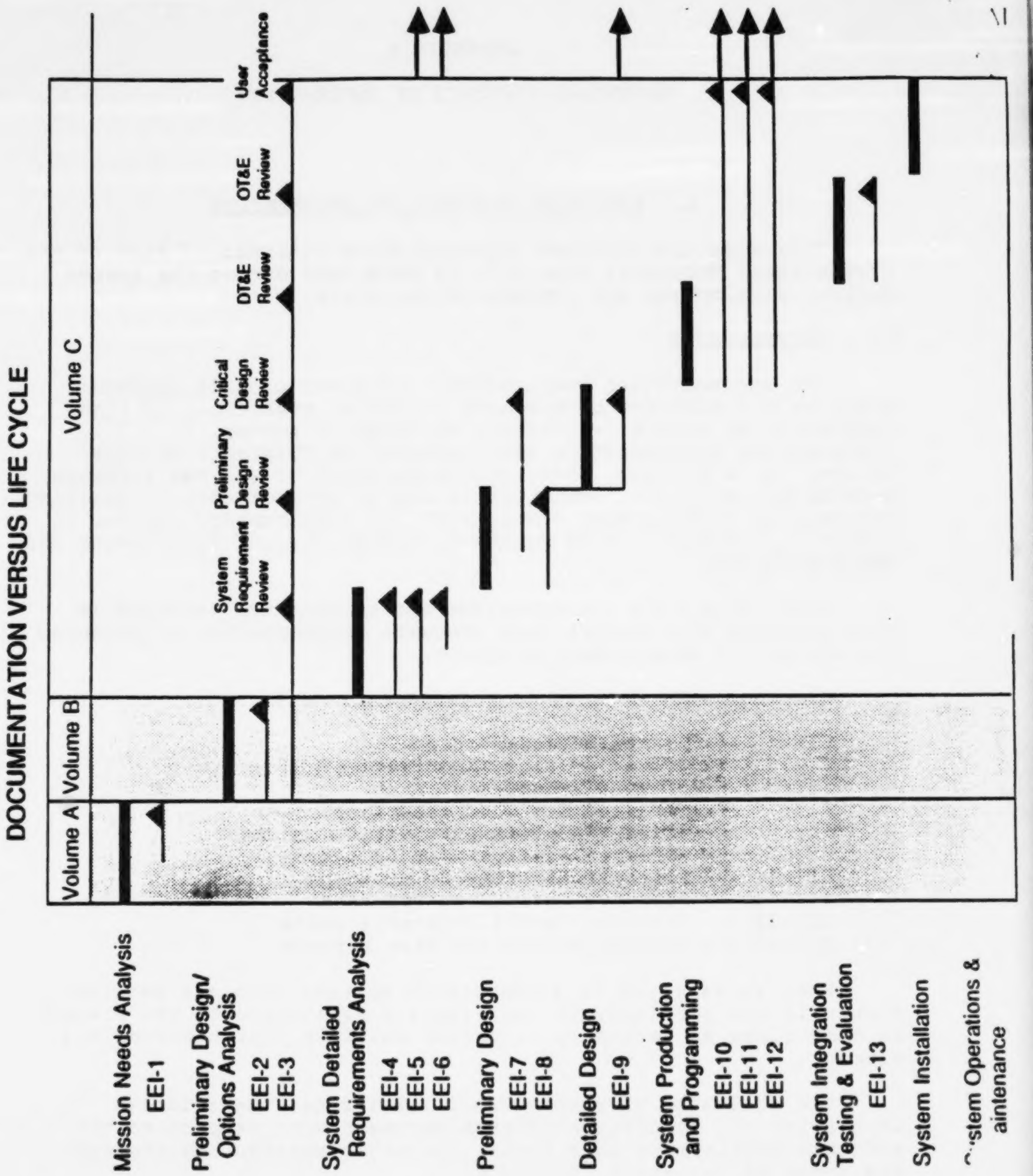
Compliance with the standards and conventions provided in this appendix will ensure that adequate documentation is produced for all system development projects.

The documents defined in this appendix are:

EEI-4 • • System Implementation Plan
EEI-5 • • System Detailed Requirements Document
EEI-6 • • Software Management Plan
EEI-7 • • Software Test and Acceptance Plan
EEI-8 • • Software Preliminary Design Document
EEI-9 • • Software Detailed Design Document
EEI-10 • • Software Maintenance Document
EEI-11 • • Software Operations Document
EEI-12 • • Software User's Reference Guide
EEI-13 • • System Integration Test Reports

When an asterisk or alphanumeric appears within a section number in the outlines, it represents a repetition of the element as many times as necessary to define multiple iterations of the element.

The following milestone chart illustrates the relative initiation and completion of each document with respect to the software development life cycle, its major phases, and the span and scope of Volumes A, B, and C.



DOCUMENTATION VERSUS LIFE CYCLE

Volume A
Volume B
Volume C
System Requirement Review
Preliminary Design Review
Critical Design Review
DT&E Review
OT&E Review
User Acceptance
Mission Needs Analysis
EEI-1
Preliminary Design/ Options Analysis
EEI-2
EEI-3
System Detailed Requirements Analysis
EEI-4
EEI-5
EEI-6
Preliminary Design
EEI-7
EEI-8
Detailed Design
EEI-9
System Production and Programming
EEI-10
EEI-11
EEI-12
System Integration Testing & Evaluation
EEI-13
System Installation
System Operations & aintenance

EEI-4 SYSTEM IMPLEMENTATION PLAN

1. INTRODUCTION
    - 1.1 Purpose
    - 1.2 Background
    - 1.3 Scope
    - 1.4 System References
    - 1.5 Terms and Abbreviations
    - 1.6 Organization of This Document

2. REFERENCED DOCUMENTS
    - 2.1 Government Documents
    - 2.2 Non-government Documents

3. IMPLEMENTATION PLAN
    - 3.1 Plan Management
        - 3.1.1 Policy Events and Actions
        - 3.1.2 Program Management
        - 3.1.3 Strategy for Acquiring Information/Data
            - 3.1.3.1 Information Collection
            - 3.1.3.2 Forms
            - 3.1.3.3 Clearance
        - 3.1.4 Strategy for Integrating with other EPA Information
            - 3.1.4.1 Environmental Data
            - 3.1.4.2 Administrative Data
        - 3.1.5 Access Policy and Standards
        - 3.1.6 Assessment of Existing Hardware/Software Alternatives
            - 3.1.6.1 EPA
            - 3.1.6.2 Other Government Agencies
            - 3.1.6.3 Commercial Vendors
        - 3.1.7 Information Systems
            - 3.1.7.1 Automated
            - 3.1.7.2 Manual
        - 3.1.8 Process and Procedure

EEI-4 SYSTEM IMPLEMENTATION PLAN (Continued)

- 3.2 Work Plans and Schedules
- 3.3 Resource Requirements
  - 3.3.1 Contractor
  - 3.3.2 Personnel
  - 3.3.3 Facilities
  - 3.3.4 Government Furnished Property
- 3.4 Integrated Project Plan

4. NOTES

5. APPENDICES

6. GLOSSARY

EEI-5 SYSTEM DETAILED REQUIREMENTS DOCUMENT

1. INTRODUCTION

1.1 Purpose
1.2 Background
1.3 Scope
1.4 System References
1.5 Terms and Abbreviations
1.6 Organization of This Document

2. REFERENCED DOCUMENTS

2.1 Government Documents
2.2 Non-government Documents

3. DETAILED CHARACTERISTICS AND REQUIREMENTS

3.1 System Definition Requirements

3.1.1 System Purpose
3.1.2 Concept of Operation
3.1.3 System Sizing and Timing Requirements
3.1.4 Design Standards
3.1.5 Design Constraints
3.1.6 Data Requirements

3.2 Subsystem Definition Requirements

3.2.1 Subsystem #1

3.2.1.1 Subsystem #1 Purpose/Definition
3.2.1.2 Subsystem #1 Interface Definition

3.2.1.2.1 Network
3.2.1.2.2 Software Systems
3.2.1.2.3 Data Base
3.2.1.2.4 Entity Relationships

3.2.1.3 Assumptions and Constraints
3.2.1.4 Subsystem #1 Level II Requirement 1

3.2.1.4.1 Level II Requirement 1 Description

3.2.1.4.1.1 Level III Detailed Functional Requirement

EEI-5 SYSTEM DETAILED REQUIREMENTS DOCUMENT (Continued)

3.2.1.4.1.1.1 Title and Description Of Level III Function 1
3.2.1.4.1.1.N Title and Description Of Level III Function N
3.2.1.4.1.n Level III Requirement n Description

3.2.1.4.m Level II Requirement m Description
3.2.M Subsystem #M

3.3 System Physical Requirements

3.3.1 HVAC and Electrical Requirements
3.3.2 Facilities Management
3.3.3 Computer Hardware Requirements
3.3.4 Computer Operating System Requirements
3.3.5 Software Utilities and Tools

3.4 System Security Requirements

3.4.1 System Backup Procedures
3.4.2 Review/Activity Log Files
3.4.3 Disaster Recovery Procedures

3.5 Quality Requirements

3.5.1 Reliability
3.5.2 Maintainability
3.5.3 Flexibility and Expansion
3.5.4 Transportability

3.6 Life Cycle Requirements

3.6.1 Software Maintenance Personnel
3.6.2 User Support and Training
3.6.3 Hardware and Supplies

4. Testing and Verification Requirements

4.1 Testing Requirements

4.1.1 Method
4.1.2 Responsibility

EEI-5 SYSTEM DETAILED REQUIREMENTS DOCUMENT (Continued)

5. Project Schedules and Work Plans

    5.1 Schedules
    5.2 Work Plan

        5.2.1 Personnel
        5.2.2 Milestones
        5.2.3 Budget

6. NOTES

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EEI-6 SOFTWARE MANAGEMENT PLAN

1. INTRODUCTION

1.1 Purpose
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1.5 Terms and Abbreviations
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2. REFERENCED DOCUMENTS

2.1 Government Documents
2.2 Non-government Documents

3. PLANNING

3.1 Project Resources

3.1.1 Contractor Facilities
3.1.2 Government Furnished Equipment, Software and Services
3.1.3 Personnel
3.1.4 Organizations Responsible for Design, Implementation, Configuration Management, Reliability and Quality Assurance

3.2 Review Responsibilities
3.3 Software Development

3.3.1 Organization Structure
3.3.2 Personnel
3.3.3 Resources
3.3.4 Software Development Tools, Techniques, Methodologies and Standards
3.3.5 Manual Procedures/Forms

4. MANAGEMENT CONTROLS

4.1 Project Schedule, Reviews and Report Controls

4.1.1 Work Plan
4.1.2 Activity Network and Dependencies
4.1.3 Risk Areas

LEI-6 SOFTWARE MANAGEMENT PLAN (Continued)

4.2 Risk Management

    4.1.1 New Technologies
    4.1.2 Backup - Recovery
    4.1.3 Manual Procedures/Forms

5. SOFTWARE PRODUCT ASSURANCE

5.1 Software Configuration Management
5.2 Software Independent Verification and Validation
5.3 Software Security
5.4 Software Reliability and Quality Control
5.5 Software Interface Definition
5.6 Software Waivers to Policy and Procedures

    5.6.1 Permanent Waivers
    5.6.2 Temporary Waivers
    5.6.3 Tools and Standards Waivers

5.7 Data Administration
5.8 Quality Assurance

    5.8.1 Program Monitoring
    5.8.2 Quality Reviews
    5.8.3 Reporting and Control
    5.8.4 Reviews

        5.8.4.1 System Requirements Reviews
        5.8.4.2 Preliminary Design Review
        5.8.4.3 Critical Design Review
        5.8.4.4 Code Reviews
        5.8.4.5 Development Test and Evaluation Review
        5.8.4.6 Operational Test and Evaluation Review

5.9 **Testing**

    5.9.1 Software Test Plan
    5.9.2 Software Test Description
    5.9.3 Software Test Procedures
    5.9.4 Conducting the Software Test
    5.9.5 Software Test Reports

EEI-6 SOFTWARE MANAGEMENT PLAN (Continued)

6. SOFTWARE DEVELOPMENT PROCEDURES

    6.1 Software Standards and Procedures

        6.1.1 Software Tools
        6.1.2 Commercial and Reusable Software

            6.1.2.1 Data Rights and Documentation
            6.1.2.2 Certification

        6.1.3 Software Test Tools
        6.1.4 Software Design

            6.1.4.1 Software Design Methodology
            6.1.4.2 Programming Language
            6.1.4.2 Interface Methodology
            6.1.4.4 Network Methodology

        6.1.5 Software Design and Coding Standards
        6.1.6 Firmware

    6.2 Software Configuration Management

        6.2.1 Configuration Identification

            6.2.1.1 Documentation Baselines
            6.2.1.2 Methods and Approach to Standards Implementation

        6.2.2 Configuration Control

            6.2.2.1 Configuration Control Flow Chart
            6.2.2.2 Forms
            6.2.2.3 Storage and Release of Master Copies

        6.2.3 Configuration Reviews

7. NOTES

8. APPENDICES

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EEI-7 SOFTWARE TEST AND ACCEPTANCE PLAN

1. INTRODUCTION
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    - 1.6 Organization of This Document

2. REFERENCED DOCUMENTS
    - 2.1 Government Documents
    - 2.2 Non-government Documents

3. LIMITATIONS/TRACEABILITY
    - 3.1 Limitations
    - 3.2 Traceability

4. TEST PLANS
    - 4.1 Software Unit Testing (includes Manual Procedures)
        - 4.1.1 Test Requirements
        - 4.1.2 Test Management
            - 4.1.2.1 Integration Test Team Organization and Responsibility
            - 4.1.2.2 Responsibilities of Other Organizations
            - 4.1.2.3 Product Control
            - 4.1.2.4 Test Control
            - 4.1.2.5 Evaluation and Retest Criteria
            - 4.1.2.6 Test Reporting
            - 4.1.2.7 Test Review
            - 4.1.2.8 Test Identification
            - 4.1.2.9 Test Data Environment
        - 4.1.3 Test Schedule
        - 4.1.4 Test Results

EEI-7 SOFTWARE TEST AND ACCEPTANCE PLAN (Continued)

4.2 Integration Testing of Software Units, Modules and Software Functions/Risk Management

    4.2.1 Integration Test Requirements
    4.2.2 Integration Test Management
    4.2.3 Integration Test Categories
    4.2.4 Integration Test Methods
    4.2.5 Integration Test Schedules
    4.2.6 Integration Test Results

        4.2.6.* (Insert Name) Integration Test

4.3 Required Resources

    4.3.1 Facilities
    4.3.2 Hardware
    4.3.3 Interface/Support Software
    4.3.4 Personnel
4.4 System Test

    4.4.1 System Test Requirements
    4.4.2 System Test Management
    4.4.3 System Test Categories
    4.4.4 System Test Methods
    4.4.5 System Test Schedules
    4.4.6 System Test Results

5. USER ACCEPTANCE

5.1 Test Team
5.2 Pretest Preparations

    5.2.1 Development of Test Scenarios and Test Data
    5.2.2 Development of Predicted Results
    5.2.3 Development of Acceptance Procedures

5.3 Test Execution

    5.3.1 Data Analysis
    5.3.2 Test Evaluation
    5.3.3 Problem Report and Problem Resolution Process

EEI-7 SOFTWARE TEST AND ACCEPTANCE PLAN (Continued)

5.4 Formal Acceptance

  5.4.1 Test Report

    5.4.1.1 Detailed Test History
    5.4.1.2 Detailed Test Results

      5.4.1.2.* (Insert Test Name) Test Results

6. NOTES

7. APPENDICES

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EEI-8 SOFTWARE PRELIMINARY DESIGN DOCUMENT

1. INTRODUCTION
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    - 1.4 System References
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    - 1.6 Organization of This Document
2. REFERENCED DOCUMENTS
    - 2.1 Government Documents
    - 2.2 Non-government Documents
3. SOFTWARE DESIGN REQUIREMENTS (SDR)
    - 3.1 Concepts
    - 3.2 Functional Flow
    - 3.n (Insert Name) Requirement
        - 3.*.1 Description of Requirements and Associated Software Design Functions (SDFs), including Manual Procedures
4. SOFTWARE DESIGN FUNCTION (SDF)
    - 4.* (Insert Name) Function
        - 4.*.1 Inputs
        - 4.*.2 Local Data
        - 4.*.3 Initiation, Timing and Sequencing
        - 4.*.4 Interrupts
        - 4.*.5 Processing
            - 4.*.5.1 Algorithms
            - 4.*.5.2 Error Handling
            - 4.*.5.3 Test Structures
        - 4.*.6 Outputs
        - 4.*.7 Adaption

EEI-8 SOFTWARE PRELIMINARY DESIGN DOCUMENT (Continued)

5. DATA BASE DESIGN
    - 5.1 Data Base Management System
    - 5.2 Data Structure (Logical Design)[1]
    - 5.3 Interrelationships
    - 5.4 Design Characteristic/Requirements Traceability
    - 5.5 Physical Design (EEI-8)[1]
6. NOTES
7. APPENDICES
8. GLOSSARY

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[1] For ADABAS refer to EPA/NCC ADABAS Application Development Procedures Manual for CDBA requirements.

EEI-9 SOFTWARE DETAILED DESIGN DOCUMENT

1. INTRODUCTION

1.1 Purpose
1.2 Background
1.3 Scope
1.4 System References
1.5 Terms and Abbreviations
1.6 Organization of This Document

2. REFERENCED DOCUMENTS

2.1 Government Documents
2.2 Non-government Documents

3. SOFTWARE FUNCTION REQUIREMENTS (SFR)

3.1 SFR External Interfaces (including Manual Procedures)

3.1.* (Insert Name) Interfacer

3.1.*.* (Insert Name) Software Unit (SU)

4. DETAIL DESIGN

4.* (Insert Name) SFR

4.*.1 SFR Inputs
4.*.2 SFR Local Data
4.*.3 SFR Processing

4.*.3.1 Control
4.*.3.2 Algorithms
4.*.3.3 Error Handling
4.*.3.4 Data Conversion
4.*.3.5 Test Structures
4.*.3.6 Manual Procedures

4.*.4 SFR Outputs
4.*.5 SFR Decomposition

EEI-9 SOFTWARE DETAILED DESIGN DOCUMENT (Continued)

4.*.5.* (Insert Name) Software Unit (SU)

4.*.5.*.1 SU Formal Parameters
4.*.5.*.2 SU Inputs
4.*.5.*.3 SU Local Data
4.*.5.*.4 SU Processing
4.*.5.*.5 SU Outputs
4.*.5.*.6 SU Limitations
4.*.5.*.7 Use of Other Elements
4.*.5.*.8 Manual Procedures

5. DATA BASE DESIGN (If Applicable)

5.1 Data Base Management System
5.2 Data Structure (Logical Design)[1]
5.3 Interrelationships
5.4 Design Characteristic/Requirements Traceability
5.5 Physical Design[1]

5.5.* File (Insert Name)

5.5.*.* Record (Insert Name)

5.5.*.*.* Field (Insert Name)

5.5.*.*.*.* Item (Insert Name)

6. NOTES

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[1] For ADABAS refer to EPA/NCC ADABAS Application Development Procedures Manual for CDBA requirements.

EEI-10 SOFTWARE MAINTENANCE DOCUMENT

1. INTRODUCTION

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2. REFERENCED DOCUMENTS

    2.1 Government Documents
    2.2 Non-government Documents

3. MAINTENANCE PROCEDURES

    3.1 Source Code Standards
    3.2 Documentation Update (including non-software elements)
    3.3 Coding and Review Process

        3.3.1 Top Down Approach
        3.3.2 Peer Review
        3.3.3 Walkthrough
        3.3.4 Team Leader Review

    3.4 Change Control Process

        3.4.1 Change Request
        3.4.2 Code Review
        3.4.3 Review and Approval

            3.4.3.1 Maintainer
            3.4.3.2 User

    3.5 Testing Standards and Procedures

        3.5.1 Test Plans
        3.5.2 Test Data
        3.5.3 Test Scenarios
        3.5.4 Test Results

    3.6 Change Implementation Methods

        3.6.1 Test to Production Method

EEI-10 SOFTWARE MAINTENANCE DOCUMENT (Continued)

4. MAINTENANCE TOOLS

  4.1 Technical Tools

    4.1.1 Processing Tools

      4.1.1.1 Compilers
      4.1.1.2 Cross Reference
      4.1.1.3 File Comparator
      4.1.1.4 Traces/Dumps
      4.1.1.5 Test Data Generator
      4.1.1.6 Test Coverage Analyzer
      4.1.1.7 Preprocessor
      4.1.1.8 Verification/Validation

    4.1.2 Clerical Tools

      4.1.2.1 On-line Editor
      4.1.2.2 Documentation Library
      4.1.2.3 Archival Processor
      4.1.2.4 Source Code Reformatter
      4.1.2.5 Data Dictionary

  4.2 Management Tools

    4.2.1 Problem Reporting
    4.2.2 Status Reporting
    4.2.3 Scheduling
    4.2.4 Configuration Management

5. SOURCE CODE

  5.* (Insert Software Unit Name) Source Listing

6. NOTES

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EEI-11 SOFTWARE OPERATIONS DOCUMENT

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2. REFERENCED DOCUMENTS
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    - 2.2 Non-government Documents
3. OPERATIONS
    - 3.1 System Initialization
    - 3.2 System Restart
        - 3.2.* (Insert Name) Function
            - 3.2.*.1 Execution
            - 3.2.*.2 Inputs
                - 3.2.*.2.1 User Inputs
                - 3.2.*.2.2 System Inputs
            - 3.2.*.3 Outputs
            - 3.2.*.4 Termination
            - 3.2.*.5 Error Messages
    - 3.3 System Manager
        - 3.3.1 Manager's Functions/Menu
            - 3.3.1.* (Insert Name) Function
    - 3.4 System Backup/Recovery Provisions
    - 3.5 System Security
4. NOTES
5. APPENDICES
6. GLOSSARY

EEI-12 SOFTWARE USER'S REFERENCE GUIDE

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2. REFERENCED DOCUMENTS

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3. DESCRIPTION OF THE SYSTEM

    3.1 System Overview and Mission Based Activities
    3.2 System Flow and Data Descriptions
    3.3 System and Program Manager
    3.4 Data Dictionary

4. SYSTEM ACCESS TECHNIQUE(S)

    4.1 Hardware/Software Interface(s)
    4.2 Menus and Other Methods of Access
    4.3 Manual Procedures

5. USER ANALYSIS / REPORTING OPTIONS

    5.1 Standard Reports
    5.2 Ad-hoc Capabilities
    5.3 Specialized Capabilities

        5.3.1 Models, Algorithms, Etc.
        5.3.2 Graphics
        5.3.3 Expert Systems
        5.3.4 Laser and Other Output Media

6. DATA ENTRY AND UPDATE PROCESSES

    6.1 Methods and Descriptions of Processes
    6.2 Data Responsibilities

EEI-12 SOFTWARE USER'S REFERENCE GUIDE (Continued)

7. USER SUPPORT AND TRAINING PROGRAM/SOURCES

    7.1 User Support
    7.2 Training Sources/Schedules

8. NOTES

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EEI-13 SYSTEM INTEGRATION TEST REPORT

1. INTRODUCTION

    1.1 Purpose
    1.2 Background
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    1.5 Terms and Abbreviations
    1.6 Assumptions and Constraints
    1.7 Organization of This Document

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3. SUMMARY OF TESTING

    3.1 Test Environment
    3.2 Chronology of the Testing Process

4. TEST RESULTS

    4.1 Resolved Incidents
    4.2 Outstanding Incidents
    4.3 Evaluation and Recommended Disposition

5. NOTES

6. APPENDICES

7. GLOSSARY